SOUTH AFRICAN SUGAR ASSOCIATION

EXPERIMENT STATION

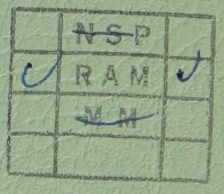
MOUNT EDGECOMBE

NATAL

REPORT

for

1960 – 1961



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The Experiment Station

The Experiment Station of the South African Sugar Association is financed wholly from funds contributed by the Sugar Industry, the South African Cane Growers' Association and the Natal Sugar Millers' Association sharing the cost of maintenance and development.

The main station at Mount Edgecombe, first established in 1925 and consisting of 116 acres held on long lease from The Natal Estates Ltd., now serves as the headquarters of the administrative, research, advisory, and extension services and is also the main centre for sugarcane breeding. Field facilities have been extended from time to time to meet the increasing demands of an expanding experimental programme.

Thus in 1946, 200 acres were acquired on long lease near Chaka's Kraal, some 25 miles further north of Mount Edgecombe. They have been developed with irrigation facilities for a wide range of field trials.

A further 300 acres were purchased outright in 1955 near Mtunzini in Zululand and this area is now being developed as an additional field trial and seed propagation station.

The Experiment Station also incorporates a Fertilizer Advisory Laboratory which provides a free advisory service to all sections of the Industry.

An extensive reference library covering all aspects of sugar production and the sciences relevant thereto is maintained at the Experiment Station. The library, and the various services it provides, is open to all members of the Industry and to approved institutions and organisations outside of the Industry proper.

Functions of the Experiment Station

The principal functions of the Station are as follows :

1. The development of new varieties of sugarcane both by breeding and by introduction and the propagation and distribution of selected varieties to meet the diverse needs of the Industry.

2. The investigation of agronomic problems of sugarcane production.

3. The studies of the soils of the sugarcane producing areas.

4. The study of the nutritional requirements of sugarcane.

5. The study of pests and diseases of sugarcane and the development of appropriate control measures.

6. Other investigations on such problems as arise from time to time.

7. The dissemination of information relating to sugarcane production.

8. The issuing of advice on fertilizer usage, disease and pest control and other aspects of crop management.

9. The exchange of information and material, and collaboration with other research institutions in South Africa and other countries.

COMMITTEE OF THE EXPERIMENT STATION
1960 - 1961

W. J. G. BARNES *(Chairman)*
O. W. M. PEARCE *(Vice-Chairman)*
W. K. BUCHANAN
G. C. FLEWELLEN
H. L. GARLAND
F. S. V. GILLATT
W. B. KRAMER
D. W. LONDON
B. S. MORRIS
C. F. POLLOCK

EXECUTIVE COMMITTEE

Members : W. J. G. BARNES *(Chairman)*
O. W. M. PEARCE *(Vice-Chairman)*
G. C. FLEWELLEN
F. S. V. GILLATT
D. W. LONDON

Co-opted from Experiment Station Staff :

J. WILSON *(Director)*
L. B. WEBER *(Secretary)*

THE EXPERIMENT STATION

MOUNT EDGECOMBE

with

THE EXPERIMENTAL FARM, CHAKA'S KRAAL, NORTH COAST, NATAL.

THE PROPAGATION FARM, MTUNZINI, ZULULAND, NATAL.

THE FERTILIZER ADVISORY LABORATORY, REDHILL, DURBAN.

List of Staff.

APRIL, 1961.

Director :
J. WILSON, B.Sc. Hons. (Dunelm)

Chief Research Officer :
J. L. DU TOIT, M.Sc. (Stellen.)

Secretary :
L. B. WEBER, F.C.C.S.

Professional Staff.

Chief Agricultural Officer : C. H. O. PEARSON, B.A. (Oxon), B.A. (Cantab.).

Agronomist : C. E. BOOTH.

Chief Research Chemist : J. L. DU TOIT, M.Sc. (Stellen.).

Soil Scientist : B. E. BEATER, B.A., D.Sc. (Agric.), F.R.I.C., F.R.S. (S.A.).

Pedologist : R. R. MAUD, B.Sc., Hons. (Natal).

Chemist : G. H. WOOD, B.Sc., Hons. (Natal).

Chemist : K. E. F. ALEXANDER.

Microbiologist : J. R. ANDERSON, B.Sc. Agr. (Natal),

Plant Breeder : P. G. C. BRETT, M.Sc. (S.A.), Ph.D. (Natal).

Assistant Plant Breeder : T. B. BRASSEY, B.A. (Oxon.).

Plant Pathologist : G. M. THOMSON, M.Sc. (Natal).

Entomologist : J. DICK, M.Sc. (S.A.), Ph.D. (London), D.I.C.

Biometrician : VACANT.

Advisory Chemist (Fertilizer) : T. A. F. SEXTON, B.Sc. Hons. (London), F.R.I.C.

Assistant Advisory Chemist : R. T. BISHOP, B.Sc. Agric. (Natal).

Regional Representatives (Extension) :

J. M. ROBERTSON, B.Sc. Agric. (Edin.).

D. P. UPTON.

D. A. ROUTLEDGE, B.Sc. Agric. (Natal).

Technical Staff.

Librarian : MISS F. G. H. WHITELEY, B.A. (Rhodes), Hons. (Natal).

Farm Managers :

F. L. ALMOND (Experiment Station).
K. W. L'ANGE (Experimental Farm).
R. B. COX (Propagation Farm).

Agricultural Assistants :

L. H. GORVETT, Dip. Agr.
R. KRUUSE, Dip. Agr.

Disease Inspectors :

H. V. FRANCES.
R. H. HALSE.

Laboratory Assistants:

MRS. M. WELLS.
MISS H. BLEVINS.

Building Supervisor :

H. G. MUNROE.

Transport Foreman :

A. E. LANG.

Clerical Staff.

MRS. N. V. SARGENT.
MISS W. N. TEALE.
MRS. L. BAPTIE.
MISS G. E. SMITH.
MRS. N. VAN DER MERWE.
MRS. N. DEKKER.

General Report

AS was to be expected, the drastic cut in sugar production which came into effect during the current season has had the immediate effect of markedly reducing the use of fertilizers throughout the industry. There is little doubt that this reduction will continue into 1961-62, possibly to an even greater extent than in the year now under review.

This "crash" action on the part of farmers in order to bring costs into line with reduced incomes is an understandable reaction in the present circumstances.

Nevertheless, there is ample evidence available from analytical data in the files of the Fertilizer Advisory Laboratory and from many fertilizer experiments, to show that the soils in many parts of the Natal sugar belt are incapable of sustaining crop yields at their present levels without the application of substantial dressings of fertilizer after each harvest. The savings in expenditure on fertilizers therefore, can be all too readily offset by, for example, the increased labour costs on account of the additional weed control required in a small crop and the need to replant an unthrifty field before its time.

Indeed, anomalous though it may sound at a time when most farmers have now a deal more cane than they are allowed to send to the mill, the present situation undoubtedly calls for an even greater intensification of production with an even greater accent on efficiency than ever before.

For the average farmer this implies that he should be able to produce his full annual crop requirements in an average season from a substantially smaller acreage than he has under cane at the present time.

Clearly such land released from cane production should be cropped for profit and not left unused as a wasting asset against the day when the lifting of restriction permits it to be replanted to cane. Small scale trials with crops such as cotton suggest that, by confining production of a particular crop to the areas and conditions best suited to it and applying the cultural techniques recommended by the appropriate commodity research station specialising in these crops in neighbouring territories, a number of crops could well be of considerable value as complementary crops to or in rotation with, sugarcane in Natal.

Such a departure from the traditional system of cane monoculture would not be nearly so revolutionary as might at first sight appear, since chief amongst such complementary and rotation crops would undoubtedly be some of the very ones which the early pioneers successfully introduced and grew on a commercial scale in Natal before sugarcane achieved its present status.

RESEARCH.

Progress reports on the activities of the various research sections at the Station are given later under separate heads. Some of the more significant developments emerging therefrom are outlined below.

The general beneficial effects of a trash blanket in ratoon crops in the main cane belt and the deleterious effects noted elsewhere in particular circumstances, have for long been ascribed as being due to a number of factors for the existence of which, little or no experimental evidence has so far been adduced. The data from a number of recording stations where daily records of earth temperatures at the surface and at 1″, 4″ and 9″ depth in the presence and absence of a trash layer are therefore of considerable interest and show very clearly the significant role played by trash in reducing both the diurnal and seasonal variations in soil temperatures.

Since no crop was grown on the soils concerned at the recording stations it is not possible at this stage to project the information further than to indicate how a newly planted or harvested field is likely to be affected by the presence or absence of trash. From a preliminary assessment however and pending the accumulation of further data it seems that insofar as soil temperatures are concerned there is a greater risk of hindering plant growth by the presence of a trash blanket in winter than there is of injury being caused to the roots in the absence of a trash cover in summer. This work is being continued in conjunction with investigations on the role of trash in relation to rainfall acceptance and soil moisture retention.

The value of irrigation as a means of maintaining levels of production, whether it be subject to restrictions or not, cannot be denied and this has been increasingly recognized by many farmers in those areas subject to erratic rainfall. It cannot be emphasised too strongly, however, that irrigation is more than a mere matter of applying water to soil and that pitfalls lie in the way of the unwary. Irrigation without control whether it be of the quality of water and the amounts applied, or of the drainage requirements associated with it, is to ask for trouble. The results of investigations carried out this year both on soils and on water supplies serve to emphasise the need for a reassessment of irrigation procedure and field

practice in certain areas of the cane belt, particularly in the Hluhluwe and Nkwaleni areas.

Of more than passing interest is the marked effect that the nutritional status of the parent plants has upon the germination of planting material taken from them. The greatly superior germinating capacity and enhanced growth rates of setts taken from plants grown on a high plane of nutrition gives strong support to the recommendations made from time to time by the Station, that greater attention to seedcane selection and the establishment of nurseries are matters well worthy of careful consideration by all growers.

Although some information has emerged from work on the vexed question of nitrogen losses arising form the use of urea, this is not such as to make necessary any alterations to the previous recommendations issued regarding the use of nitrogenous fertilizers viz. that the amount of nitrogen applied is more important than the type of carrier and that in general the best form is that which is cheapest to buy and apply.

Although not a research matter it may be noted that the first wholly Natal-bred variety N.50/211, now symbollically renamed "Salvo" to indicate that it is only one of many superior varieties which the Breeding Section intends producing for the Industry, seems to be even more popular with growers than was first considered likely, this in spite of its somewhat low sucrose content.

The results from disease surveys continued to indicate that the variety N:Co.376 which is intolerant to mosaic was being increasingly affected by the disease, wherever it was found in close promixity to plantings of the mosaic tolerant variety N:Co.339. It became necessary during the year, therefore, to recommend that growers in the worst affected areas should eradicate N:Co.339 at the first available opportunity. Since satisfactory substitutes for N:Co.339 in the form of N:Co.382, Salvo (N.50/211) and N:Co.376 itself are now freely available this recommendation should involve little hardship.

The more recent results from spacing trials indicate that the last word has not been written on this debatable subject, particularly when cane is grown under conditions where adequate moisture is available, either naturally or with irrigation, and more particularly overhead irrigation. It is also as well to note that such experiments demonstrate the need to consider more than merely final yields either of cane or sucrose when attempting to assess the merits and demerits of a particular treatment.

Interesting developments have also emerged from the work in progress on the effects of weeds on the growth of young plant cane. Though incomplete, the results obtained so far suggest that there is a critical stage during the early stages of crop establishment when further development and growth of the young plant is inhibited if weeds are not eliminated, particularly from the row, and further that once eliminated little benefit is likely to be derived from additional in-the-row weeding. If this is indeed the case, the whole approach to weeding can be greatly simplified, particularly when attempting to assess the relative merits and economics of herbicides, mechanical implements, etc.

SUGARCANE QUARANTINE.

The reversion of sugarcane quarantine from Stellenbosch to the Durban glasshouse has enabled the number of varieties imported from overseas sources to be stepped up and the end of the year saw 68 varieties at various stages of quarantine successfully established and under observation. The co-operation and assistance of the Division of Plant Control and Quarantine in arriving at this happy state of affairs is gratefully acknowledged.

ADVISORY AND EXTENSION SERVICES.

Although lack of suitable recruits has so far precluded the planned expansion of extension services, it has been possible for field staff to spend a great deal more of their time on extension matters and less on the management of experiments than heretofore. All staff connected with advisory and extension work have reported a great interest by growers in the possibilities of growing complementary crops and a marked lack of interest in sugarcane ! In the face of colossal surpluses of cane destined to be left standing over at the end of the season — currently estimated at 4 million tons, but probably more — it has indeed been a difficult if not insuperable task to maintain enthusiasm.

Surplus cane and the virtual elimination of replanting from the working programme of many growers saw the newly instituted nursery inspection service get off to a rather slow start. This was turned to advantage however by diverting the officer concerned to disease survey work which has thus progressed further than had been anticipated.

ADMINISTRATION AND SERVICES.

Authority was granted during the early part of the year to proceed with the construction of a new laboratory wing at the Experiment Station, Mount Edgecombe, as part of the development plan drawn up in the previous year.

The new wing is designed to accommodate the Fertilizer Advisory Laboratory, the Soils, Plant Nutrition, Agriculture and Biometry Sections as well as an extension to the Library, a Conference Room, Committee Room and new administrative offices. The new wing will be joined to the present main block by the library extension.

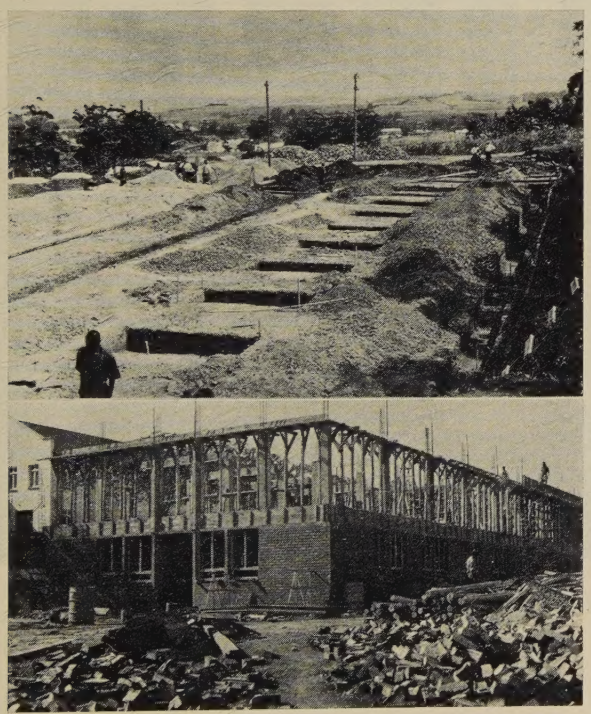
The Building Section commenced work on 1st March and up to the end of June had maintained satisfactory progress.

DELEGATIONS, VISITS, ETC.

The Director and Dr. J. Dick, Entomologist, attended the Second Congress of the Mauritian Sugar Technologists' Society held at Réduit between 6th and 10th June, 1960.

The Director and Dr. P. G. C. Brett, Plant Breeder, visited the sugarcane producing areas of Queensland and Northern New South Wales during October-November 1960.

Dr. B. E. Beater and Mr. R. R. Maud visited a number of agricultural research institutions and commodity research stations in Uganda, Kenya, Tanganyika, and Southern Rhodesia in April 1961.



New Laboratories and Offices at the Experiment Station.
(I) The first concrete being poured into the foundations on 20th March, 1961.
(II) The stage reached by 6th July, 1961. Biology wing in background.

REPRESENTATION.

The Experiment Station was represented on the following Committees by the members of staff noted :

(a) Industrial Field Mechanization and Labour Saving Committee — *The Director.*

(b) Advisory Research Committee of the Sugar Milling Research Institute — *The Director and the Chief Research Officer.*

(c) Advisory Committee for the Pongola Settlement — *The Chief Research Officer.*

Mr. J. L. du Toit, Chief Research Officer, was elected President of the S.A. Sugar Technologists' Association for the year 1959-1960.

Dr. J. Dick, Entomologist, and Mr. J. Wilson, Director, served on the Council of the above Association during the year.

TECHNICAL CO-OPERATION.

It is particularly pleasing to be able to report that the Soils Section in recent months has undertaken mineralogical studies of soil profiles in Swaziland at the request of the Department of Land Utilization, Bremersdorp, and that this has led to an unofficial conference of soil scientists drawn from the South African Sugar Association, S.A. Government Departments, the University of Natal, Swaziland Government, and Moçambique for the purpose of exchanging views and the possible co-ordination and standardisation of soils studies in the regions concerned.

It is also gratifying to record a most instructive and helpful visit from Dr. F. Fournier, Director of the International Soils Bureau (B.I.S.), Paris.

The Station was fortunate to receive a brief but most helpful visit from Dr. A. C. Hayward of the Commonwealth Mycological Institute. Dr. Hayward, who had previously visited Mauritius, Reunion and Madagascar at the request of the Governments concerned to investigate common problems of gummosis in sugarcane, spent two days in Natal before returning to London. During this time he was able to see and collect specimens of gummosis from Natal cane areas, and discuss various aspects of the problem with the Pathologist. Arrangements were also made for collaboration in further studies of this disease, which is of considerable importance in parts of the cane belt.

ACKNOWLEDGEMENTS.

The Experiment Station Staff acknowledges with grateful appreciation the co-operation received from other institutions and organizations both from within and beyond the borders of South Africa.

Thanks must also go to the many members of the South African Sugar Industry who, by their active co-operation and assistance, have enabled an extensive programme of field experimentation to be satisfactorily concluded in spite of difficult circumstances.

Plant Breeding. Preparing a marcotted flowering stem for crossing in the greenhouse.

Soils

Soil Scientist : B. E. BEATER

DISTRIBUTION OF SOILS.

(a) Soil group classification.

DURING the year under review, soil mapping was continued north of Empangeni, commencing from the Enseleni River. The break in mapping the area north of the Enseleni River was occasioned by mapping of the Nkwaleni, Eshowe and Entumeni areas, details of which were presented in the annual report for 1959-60.

North of the Enseleni River the sugar belt is very scattered, except for concentrations of farms along the railway line and in the Umfolozi area. The greater part of the area between the Enseleni and Umfolozi Rivers comprises red and grey Recent Sands, although in the west, there is a narrow strip of Tugela schist soil.

A feature of the grey sands in this area is the frequent occurrence of pans or swamps which are sites of accumulation of organic matter. Cane does well in these localities, due largely to the adequate supply of water. In extreme cases, however, the organic matter is so high as to affect sugarcane growth adversely. A large area of this type of "soil" occurs on the south bank of the Umfolozi River. An interesting feature observed, is that when planters burn cane growing in these localities, they have to extinguish the burning soil with water.

In many areas the relatively poor red and grey Recent Sands yield good crops of cane, a fact which is attributable in part to the high rainfall in this area and also to sound farming practice. Nevertheless, most of these farms combine saligna gum plantations with cane.

In the Umfolozi area, considerable areas of Cretaceous soils yielding crops of cane were encountered. The Cretaceous formation, which is a calcareous sediment, in many places crowded with molluscan and other remains, underlies the red and grey sands, but in turn largely overlies granite.

At Umkwelane Hill, south west of Mtubatuba, undisturbed Cretaceous lies across a large geological fault which drops the Stormberg basalt against the granite. The drop is of the order of 1 mile vertically. That the Cretaceous is undisturbed, shows that no earth movements have taken place since its deposition. The outcrop of the Cretaceous rocks, and therefore the overlying soil, is limited to those areas in the vicinity of rivers where erosion has removed the covering of younger sands. Cretaceous soils are divided into two series, one a heavy black clay loam (Haig series) and the other a low-lying greyish sandy loam (Greens Island series). Soils of the former series are highly productive while the latter are not as fertile.

As is well known, the alluvial soils of the Umfolozi flats include some of the most fertile in the industry. By no means the entire flats has the highly productive typical clay loam, for many areas consist of much less fertile soils and in other places there are stretches of barren sand which can scarcely support a crop of cane at all. This is due to the vagaries of the river depositing different materials during floods. A distinctive feature is that the Umfolozi River in many places is contained by levees at a level above the surrounding flats. This of course leads to the devastating inundations which occur from time to time in this area when the river level rises appreciably so as to overtop its banks.

On the north bank of the Umfolozi River, farms are composed mainly of red sands, but further northwards the grey sands become predominant once more. An interesting fact is that at Uloa, sugarcane is found growing on soils derived from Tertiary rocks. The area of these soils under cane, however, is so limited that for mapping purposes this formation is grouped with soils from Cretaceous sediments.

The difference in soils observed even among like parent material is sufficiently striking to enable them to be distinguished fairly readily in the field. This once more illustrates that parent material is the main soil forming determinant.

(b) Soil cartography.

(i) *Painting estate maps :* This work has continued steadily and is almost abreast of the field survey operations. Maps of the Eshowe and Entumeni area have now all been painted on linen and those for Nkwaleni are well in hand and will shortly be completed.

(ii) *Preparation on strip map :* Data from estate maps is regularly transferred to the Zululand strip map, which is on a scale of 1 mile to the inch. This map will in due course be incorporated in the Report on the soils of Zululand.

(iii) *Computation of areas :* The areas of soil groups on the various estates and the amounts actually under sugarcane have continued to be computed. This will finally yield the overall acreage of each soil group in the industry, and useful information relative to the performance of

varieties in the field together with the possible effect of different soils on the quality of juices entering the various factories of the industry.

(c) **Soil sampling.**

A necessary feature of the soil survey has been the study of soil profiles and the sampling of test pits. Test pits are frequently necessary to elucidate the true nature of the soil before it can be classified. Numerous test pits have to be excavated and studied before new soil series can be established.

With the discovery of the many new soil series in Zululand, this aspect of soil survey has of necessity been rather more time consuming than in the areas surveyed previously.

CHEMICAL PROPERTIES OF SOILS (SOIL FERTILITY)

(a) **Available plant nutrients.**

The study of methods of extraction of available phosphates, reported on previously, has been completed. The results indicate that of all the six methods investigated for available soil phosphate, no single one is particularly superior. There is a reasonable degree of reliability obtained from any one method. Time of manipulation, coupled with other analytical considerations, would appear to be the deciding factor in the choice of any method for routine work.

(b) **Analyses of soil profiles.**

As indicated previously much work in this field has been undertaken over the past year. From these analyses the overall picture of each soil group is obtained and even with regard to long established series, much analytical work is undertaken to characterise each series.

Other analyses have included exchangeable bases and carbon and nitrogen estimations. These analytical data are being collated for future publication in the form of a bulletin on the soil series of the sugar belt. As indicated in a previous report, the soil series is the fundamental unit of study, and much work in future will be devoted to this field.

(c) **Miscellaneous.**

During the year a very thorough examination of the reliability of soil pH, pH meters and electrodes has been carried out. It was found that pH meters were in general very reliable, but that the main sources of error in the determination of soil pH values lay in the glass and reference electrodes. Glass electrodes have to be kept scrupulously clean at all times and in addition more reliable readings were found to result from keeping the soil suspension constantly agitated.

A further aspect of study has been to investigate the availability of nitrogen in the soil. Ordinarily this involves laborious incubation procedures, but with the introduction of a new rapid technique, a considerable saving of time can be effected and the method more practicable for routine research. Preliminary investigations have been undertaken and it is intended to continue with further study.

(d) **Natural waters.**

Numerous determinations of the suitability of various waters for irrigation have been undertaken during the year. One interesting feature of this work has been the investigation of fluorine in stream waters. This was undertaken because payable quantities of fluorspar had been located in the vicinity of Sinkwazi. It was found that in this region the fluorine content of stream waters was abnormally high.

PHYSICAL PROPERTIES OF SOILS.

An increasing number of physical analyses of the main sugar belt soils has been undertaken during the current year. The main emphasis has been on the moisture retention properties of the soils. Complete moisture retention curves for all the top soils of the main groups have been completed, and it is intended to continue this study to the lower levels of each soil profile. As is to be expected with the wide variety of soils in the sugar belt, moisture retention characteristics also vary considerably.

Of the common sugar belt soils, the black dolerite (Rydal Vale series) holds the most moisture available to the plant, while the grey Recent Sands (Fernwood series) holds the least. Of course depth of profile enters into the applicability of these figues to field practice, since for example, the grey sands can be of great depth, while black dolerites are usually not more than two feet in depth.

A number of moisture retention characteristic determinations has been undertaken for individuals and companies, especially those practising extensive irrigation. These determinations enable far greater control of irrigation to be maintained.

Infiltration and permeability tests have been carried out both in the field and in the laboratory. The serious limiting factor here is inhomogeneity of the soil, but it is nevertheless expected that rough guides to these values can be obtained from the varying soils.

Compaction studies for the Dwyka, T.M.S. (ordinary), red Recent Sands, Lower Ecca shale, Middle Ecca shale and red dolerite soils have been carried out with the object of finding at what soil density plant growth becomes impeded. In addi-

tion, a number of field experiments has been undertaken in co-operation with the Field Mechanisation Engineer.

SOIL TEMPERATURES.

Records of soil temperatures both on bare ground and under trash were continued during the year. The co-operation of the various recorders within the industry, is greatly appreciated, as without their assistance it would not have been possible to carry out this study.

The importance of these records centres round the blanketing effect of trash. Points of interest which can be commented on at this stage are as follows :

Maximum and Minimum temperatures.

Greater diurnal variations occur on bare ground than under trash. In fact in some localities there has been a remarkable heating at the surface, influenced by both the aspect of the site where the records are taken and the colour of the soil, darker soils tending to become hotter. The trash cover eliminates these variations.

Owing to the protection of trash, seasonal temperature fluctuations under the cover are considerably reduced, particularly with respect to the maximum temperatures. There is also, as would be expected, less fluctuation of temperature throughout the year.

The range of bare ground maximum and minimum temperatures is 30° - 140°F, whereas under trash this is 40° - 80°F. There is quite an appreciable variation between districts.

Average surface temperature of bare ground in July is about 10°F higher than under trash, indicating the cooling effect of trash during winter.

Earth Thermometers.

With increasing depth there is a delay in temperature adjustment in the soil.

The temperatures at the 1 inch depth is lower by almost 12°F under trash as compared with bare ground.

At 4 inch depth this temperature difference is reduced to about 9°F.

At 9 inch depth the difference is still high, namely about 5°F.

The overall difference in temperature between bare ground and trash for all depths is about 9°F, which is considerable. The mean for bare ground over ten months from five of the centres where observations are taken is 76.2°F as against 67.6°F for land under trash. This is significant, as the minimum root temperatures for satisfactory growth has been found in Hawaii to be very close to 64°F. The optimum ground temperature of the root zone is about 85°F. The minimum soil temperature for germination of cane is 70°F, below which the setts will not germinate according to Hawaiian research. The minimum air temperature for growth of cane is about 66°F, below which the growth is slowed to a considerable extent, regardless of root temperature.

Fig. 1. depicts graphically the range of soil temperatures recorded at various depths in the presence and absence of trash at Mount Edgecombe and Wartburg and indicates the great differences attributable to locality.

With more complete records, a more scientific examination of, amongst other things, the advantages and disadvantages of trashing and burning will be possible. Hitherto only scanty information on the soil temperatures at various points in the sugar belt has been available, and the preliminary information now available suggests the need for further investigation.

DIFFERENTIAL THERMAL AND MINERALOGICAL ANALYSES.

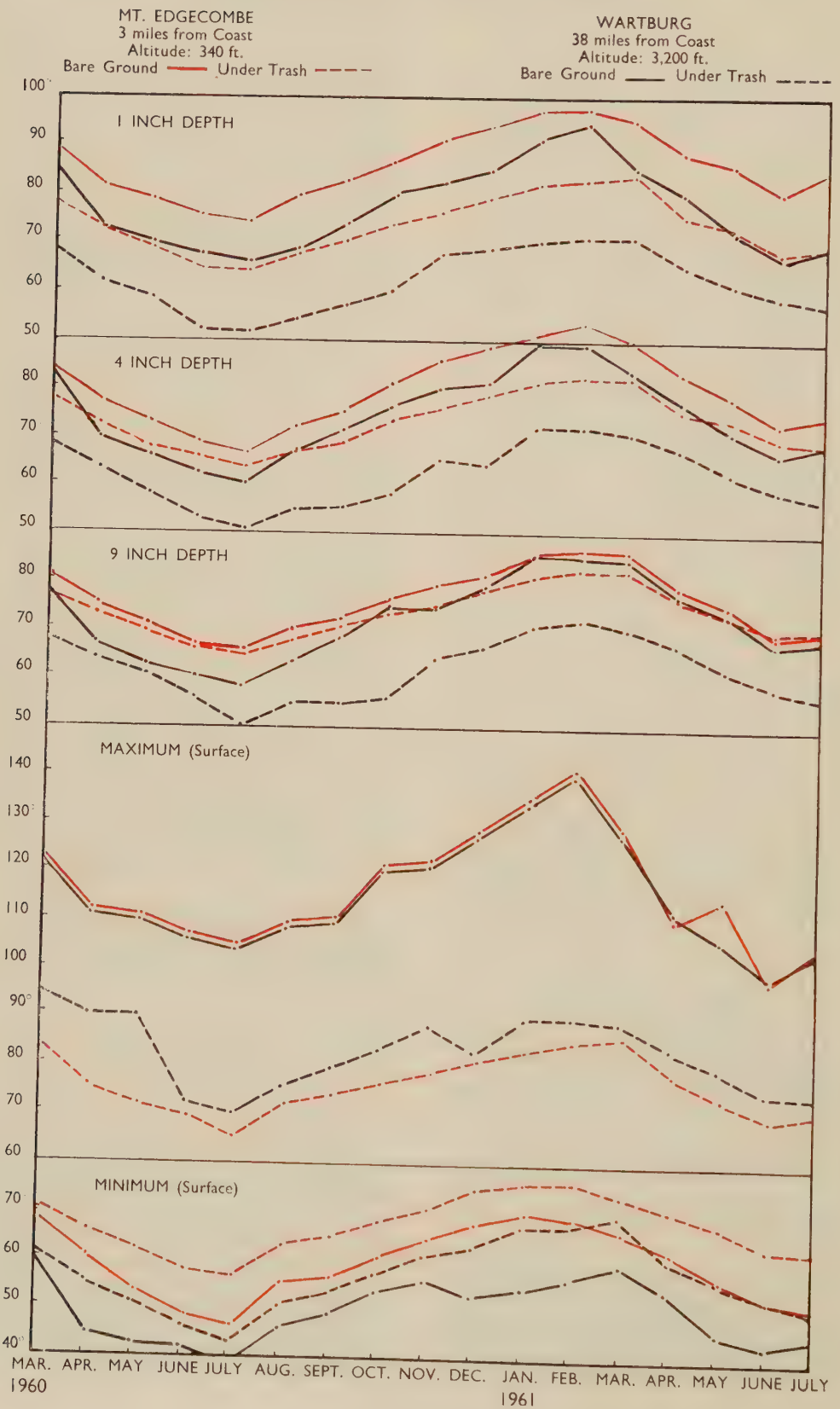
The differential thermal analyses to determine the clay constituents have been continued on the main soil series of the industry. In addition to the surface soil, the subsoil horizons are also analysed, as this information is useful in deducing the genetic characteristics. The type of clay present in soil has a large bearing on its productivity, since fixation of phosphate and potash fertilisers by clay minerals varies with the type of mineral present. For example, the vermiculite type of clay has the ability to fix ammonium ions.

The minerals present in a soil have a direct bearing on its natural fertility, for it is from the weathering of soil minerals that plant nutrients are in the main derived.

SOILS AND IRRIGATION.

With the increasing use of irrigation in the more arid portions of the industry, measures to combat and ameliorate the development of saline (mainly calcium and magnesium salts) and alkali (mainly sodium salts) soils have to be considered. Under ordinary dry land farming conditions, this problem does not normally arise, but with the application of large amounts of irrigation water, salts are drawn to the surface from lower levels and accumulate there by evaporation. This cumulative process, may in certain circumstances, ruin large areas of productive land.

FIGURE 1.
MEAN MONTHLY SOIL TEMPERATURES (°F) FROM TWO CENTRES WITHIN THE SUGAR INDUSTRY



It has to be borne in mind that alkali-saline development can be attributed to a number of causes; e.g.:— (a) A non-susceptible soil affected by poor quality irrigation water; (b) a susceptible soil affected by good irrigation water and (c) a susceptible soil aggravated by a poor quality water. The most common cause encountered in Zululand is that noted under (b), where irrigation water is taken from the large swifter-flowing rivers.

There are, however, numerous instances which fall under (a) and (c), noteworthy among these is the usage of very poor quality irrigation water by planters in the dry Hluhluwe area. Some water samples from this area recently analysed showed that, in addition to having a high salinity, they also have an unfavourable "sodium ratio". In fact these waters are classified as being among the very poorest quality possible for irrigation purposes, having a very high salinity hazard and very high sodium (alkali) hazard. It may be possible to remedy the effects of this poor water to some extent by using it only on permeable soils with adequate drainage to leach harmful salts. In addition, gypsum or other amendments, may be added to the irrigation water in order to obtain more favourable "sodium ratio".

Other remedial measures would include the use of large amounts of filter press cake, burning of trash and the high ridging of inter-rows to draw salts away from the plant zone.

As is well known, the Pongola area has been affected by alkali accumulation. Here it is a case of a susceptible soil being affected by good quality water applied in excess. Unfavourable conditions likewise appear to be developing in a more subtle manner in many parts of the Nkwaleni Valley settlement, and elsewhere, and may ultimately lead to reduced tonnages if remedial measures are not adopted.

Plant Nutrition

Chief Research Chemist : J. L. DU TOIT

NITROGEN RESPONSES IN PLANT CANE AND RATOONS.

IN South Africa, as in a number of other sugarcane growing countries, it has generally been found that responses to nitrogen are better and more frequent in ratoons than in plant cane. There are, however, exceptions to this rule. Thus in soils derived from Table Mountain sandstone, including the mist belt soils, responses to nitrogen are quite general also in plant cane and it is doubtful whether any greater responses are obtained in ratoons; but in most other soils the economic optimum level of nitrogen applications to ratoons is appreciably higher than to plant cane and it may on occasions even be difficult to demonstrate any significant responses in plant cane.

The Regional Fertilizer Trial series now being harvested has confirmed and emphasised these findings and has added considerably to our knowledge on the subject.

On soils derived from Table Mountain sandstone, including the mist belt soils and from granites, the nitrogen treatments were 60, 120, 180, and 240 lbs. N per acre for plant cane and 100, 200, 300 and 400 lbs. N per acre for ratoons. It was anticipated that on practically all of these soils, crops would respond to nitrogen as plant cane and the possibility of high nitrogen requirements in ratoons were investigated. As pointed out in the Annual Report for 1959-60, the optimum economic level of nitrogen indicated for plant cane was about 120 lbs. N for this group of soils. During the past year, ten of these trials were harvested as ratoons and in no case was a statistically significant response found to applications of nitrogen in excess of the 100 lbs. N per acre here used as the lowest level. The average results obtained from these ten experiments and comparison with the plant cane results are given in Table I.

Table I

	TREATMENTS	Tons Sucrose per Acre	
N1	100 lbs. N per acre	7.80	Ratoon
N2	200 lbs. N per acre	7.91	Ratoon
N3	300 lbs. N per acre	8.01	Ratoon
N4	400 lbs. N per acre	7.61	Ratoon
N1	60 lbs. N per acre	8.86	Plant Cane
N2	120 lbs. N per acre	9.50	Plant Cane
N3	180 lbs. N per acre	9.41	Plant Cane
N4	240 lbs. N per acre	9.35	Plant Cane

Obviously the high levels of nitrogen here tested out on the ratoons yielded neither significant nor profitable responses. The same applies for levels greater than 120 lbs. N per acre for plant cane. From these results, and further similar results will no doubt become available during the year, it must be concluded that for this group of soils

a higher application of nitrogen in ratoons than in plant cane is not warranted.

This conclusion, however, certainly does not hold good for other soils. Here the nitrogen treatments were 0, 50, 100 and 150 lbs. N per acre in plant cane and 0, 100, 200 and 300 lbs. N per acre in ratoons.

Of the eight experiments now harvested as both plant cane and first ratoons, only two showed statistically significant responses in plant cane, but no less than six of the same experiments when harvested as first ratoons showed significant or highly significant responses to nitrogen. These results are graphically illustrated in Figure I (see page 20).

The average response to nitrogen in the ratoons is here much better than in plant cane. There were actually a few instances where no response to nitrogen was obtained in plant cane and yet higher applications of nitrogen even out-yielded the 100 lbs. per acre level significantly in the ratoons. Thus in one instance the plant cane yields were :

Table II

	TREATMENT	Tons Sucrose per Acre
N1	0 lbs. N per acre	11.84
N2	50 lbs. N per acre	11.81
N3	100 lbs. N per acre	11.83
N4	150 lbs. N per acre	11.91

In the first ratoon, however, the following results were obtained :

Table III

	TREATMENT	Tons Sucrose per Acre
N1	0 lbs. N per acre	8.42
N2	100 lbs. N per acre	9.44
N3	200 lbs. N per acre	10.87
N4	300 lbs. N per acre	11.65
Least significant difference :		*2.13 @ 5%*
		2.98 @ 1%

In this particular instance there was apparently no need for nitrogen in plant cane, whereas an application of 300 lbs. N in the ratoon would have proved most remunerative. This is, however, a somewhat extreme example which is nevertheless indicative of a general tendency in this group of experiments which have shown a much better response to nitrogen in ratoons than in plant cane. In fact a number of other experiments harvested recently as plant cane after completing a first cycle of plant and ratoons, have shown similar results on these soil groups. Thus in an experiment sited on a Dwyka soil, while 100 lbs. nitrogen per acre raised the yield in tons cane per acre by only 2 per cent in plant cane, the same application gave increases of 29, 53 and 51 per cent respectively in first, second and third ratoons. This year, after replanting the experiment on the same plots, the plant cane crop showed 14.3 per cent increase due to a 100 lbs. N per acre application.

SPLIT DRESSINGS OF NITROGEN.

Perhaps because experimental evidence is not very conclusive one way or the other, the subject of splitting nitrogenous dressings in sugarcane remains somewhat controversial in many cane producing countries. Our past results did not show any real advantage of splitting moderate dressings of nitrogen, but because the practice still persists in many parts, it was decided to re-examine the situation and in recent years a number of experiments was planted to elucidate the problem.

On a Table Mountain sandstone soil where a plant cane crop has shown excellent responses to nitrogen applications, a ratoon crop was top dressed with 225 lbs. N per acre as urea. This amount was either applied all at once when the ratoon was about two months old or the dressings were split in various ways. The results obtained were as follows :

Table IV

Amount of N applied and time	*T.S.A.*
225 lbs. at 2 months	11.04
75 lbs. at 2m. + 150 lbs. at 5½m.	11.17
75 lbs. at 2m. + 150 lbs. at 8½m.	9.77
75 lbs. at 2m. + 150 lbs. at 14m.	9.97
75 lbs. at 2m. + 75 lbs. at 5½m. + 75 lbs. at 8½m.	11.00
75 lbs. at 2m. + 75 lbs. at 5½m. + 75 lbs. at 14 m.	10.43
75 lbs. at 2m. + 75 lbs. at 8½m. + 75 lbs. at 4 m.	10.10
75 lbs. at 2m. + 50 lbs. at 5½m. + 50 lbs. at 8½m. + 50 lbs. at 14m.	10.41

In this crop cut as 21½ months old cane on a site where a response to nitrogen could be confidently expected there was no statistically significant difference in the results obtained. There was certainly nothing to be gained in splitting the nitrogen dressings here.

In an experiment on red Recent Sand the average yield of eighteen plots receiving 100 lbs. per acre N in one dressing as ammonium sulphate was 9.86 tons sucrose per acre. Where this dressing was split in two 50 lb. per acre N applications the average yield was practically identical at 9.85 tons sucrose per acre.

In another experiment on a red Recent Sand applications from 100 to 300 lbs. N per acre as urea were applied either as a single dressing or as split dressings. The results of this experiment was as follows :

Table V

	Treatment	*T.S.A.*
No	No Nitrogen	9.44
N1	100 lbs. N per acre after harvesting	10.28
N2	50 lbs. N per acre + 50 lbs. N after 12 months	10.41
N3	200 lbs. N per acre	10.29
N4	100 lbs. N per acre + 100 lbs. N after 12 months	10.40
N5	300 lbs. N per acre	10.51
N6	150 lbs. N per acre + 150 lbs. N after 12 months	10.54
N7	150 lbs. N per acre + 150 lbs. N after 6 months	10.21
N8	100 lbs. N after harvest + 50 lbs. N after 6 months + 50 lbs. N after 12 months	10.33
	Least significant difference :	*0.62 @ 5%*
		0.84 @ 1%

Although there was a highly significant response to nitrogen in this experiment, there was no need to apply nitrogen in excess of 100 lbs. N per acre and there was no difference in the response to nitrogen whether the applications were split or applied as a single dressing.

Recent experiments therefore confirm our past results and show that responses to nitrogen can be just as good from a single as from a split application of nitrogen. Where we have failed to get enhanced responses to split dressings of nitrogen, the obvious recommendation must be to apply the more economic single dressings.

ECONOMIC AND MAINTENANCE DRESSINGS OF POTASH.

Using on plant cane, levels of 0, 100 and 200 lbs. K_2O per acre in the Regional Fertilizer Trials, it was found that on the average, dressings up to 200 lbs. K_2O per acre were quite economic. In the ratoons the applications were 0, 150 and 300 lbs. K_2O per acre. Eighteen of these trials have now been harvested as ratoons and nine gave significant or highly significant responses to potash. In the plant cane crops, eight of the nine also gave significant or highly significant increases due to potash applications. A comparison of the results of these eighteen trials may be of interest.

Table VI

	Plant Cane	*T.S.A.*		*Ratoons*	*T.S.A.*
K1	0 lbs. K_2O per acre	8.15	K1	0 lbs. K_2O per acre	6.71
K2	100 lbs. K_2O per acre	8.75	K2	150 lbs. K_2O per acre	7.68
K3	200 lbs. K_2O per acre	9.13	K3	300 lbs. K_2O per acre	8.01

The patterns of responses in plant cane and ratoons are thus very similar. The actual and relative responses seem however higher in ratoons than in plant cane, but this may simply be due to the fact that in ratoons the soil in control plots would have reached a stage of greater depletion of potash. From these results one may be tempted to conclude that a level of 300 lbs. K_2O per acre may be just economical in ratoons, and this conclusion may in fact be valid for soils extremely deficient in potash, but it should be borne in mind that these results were mostly derived from

soils of the Table Mountain sandstone (including the mist belt) and granite groups and that these soils generally respond well to potash. Furthermore 300 lbs. K_2O per acre does not from these results appear to be the most economic level of potash application and in practice, unlike in these experiments, extreme deficiencies would have been rectified or partly rectified in plant cane crops. It is quite clear that the response curve is one of diminishing returns. The response to 150 lbs. K_2O per acre has been quite spectacular and it would appear that in ratoons as in plant cane, 200 lbs. of K_2O per acre may well be applied profitably to a large percentage of our soils. There are other soils though where no increased yields are obtained from potash applications and the only reason for applying potash here would be to maintain the existing level of potash in the soils.

In these experiments soil analyses were done before planting and after the harvest of each crop. In addition, representative samples of cane were also analysed. It is therefore possible to determine the amount of potash lost in the cane crop as well as to examine the fall or rise of available potash in the soil for different treatments. The average results obtained in the nine experiments where significant responses were found were as follows :

Table VII

	lbs. K_2O per acre		
	K_1	K_2	K_3
Potash added in plant cane	0	100	200
Potash added in 1st ratoon	0	150	300
Potash losses in millable cane — Plant cane	50	58	79
Potash losses in millable cane — 1st ratoon	53	82	102
Potash in top 6 ins. soil before planting	216	210	211
Potash in top 6 ins. soil after plant cane	171	182	215
Potash in top 6 ins. soil after 1st ratoon	133	178	260

Where no potash has been added in the control plots the level of exchangeable potash in the soil falls as can be expected and the fall appears to be slightly less than the amount of potash removed in the crop. There is also a fall where 100 lbs. K_2O had been added in plant cane to the medium level plots although the potash added is well in excess of the amount removed in the crop. The same applies to a lesser extent to the ratoon crop which had 150 lbs. K_2O per acre added. However, where 200 lbs. K_2O per acre were added in plant cane the exchangeable potash increased slightly from 211 lbs. K_2O per acre to 215 lbs. per acre. Where 300 lbs. K_2O per acre was added in the ratoon the increase was greater from 215 lbs. to 260 lbs. K_2O per acre.

From these results it appears that about 200 lbs. per acre K_2O will be required to maintain or perhaps to build up slightly, the potash level in the soil. Much the same applies to those experiments which did not give significant responses, but here the exchangeable potash in the control plots averaged about 400 lbs. K_2O per acre. It is essential to avoid further depletion in a potash deficient soil and these results show that it can be achieved by adding 200 lbs. per acre K_2O per crop and that such an application will also give a profitable return in cane harvested.

On the other hand there seems to be no reason at all to maintain the potash level in soils high in potash. Such a procedure will not only be unnecessary where regular analyses are done on soils and leaves but will also be most unprofitable. Fortunately the potash status of a crop of cane can be fairly accurately assessed by either soil or leaf analyses.

PHOSPHATE ACCUMULATION AND RESPONSES.

There can be no doubt that the phosphate status of the soils of the sugar belt has been improved greatly as a result of the application of phosphatic fertilizers and filter cake and where most of the soils were deficient in phosphate in their natural state, very high levels of phosphate are now occasionally found in some areas. Unfortunately the Regional Fertilizer Trials did not add much to our knowledge of phosphate responses. The reason for this was that there were only two levels of phosphate included in the design and that a zero level was only used where the soil phosphate was high and a response unlikely.

In all other cases the lower level was 100 lbs. P_2O_5 per acre in plant cane. The top level was 200 lbs. P_2O_5 per acre in all cases both in plant cane and in ratoons. In the ratoons no additional phosphates were applied to the P_1 plots.

It is of interest to note that in the eighteen ratoon experiments harvested there were two instances where 200 lbs. P_2O_5 per acre did not outyield 100 lbs. P_2O_5 per acre significantly in plant cane and yet a highly significant response to phosphate was obtained in the ratoon crop.

Analytical data show an appreciable accummulation of phosphate in soil for the high application in the ratoon. Thus where no phosphates were added, the level of available phosphate fell on the average from 73 lbs. P_2O_5 per acre in 6 inches of soil just after the plant cane crop to 51 lbs. P_2O_5 per acre after first ratoon. During the same period of approximately two years the plots receiving super-phosphates equivalent to 200 lbs. P_2O_5 per acre showed an increase in available phosphate from 85 to 129 lbs. P_2O_5 per acre.

An application of 200 lbs. per acre of P_2O_5 is excessive in ratoons and leads to an appreciable increase in available phosphate in the soil in spite of a certain amount of fixation that takes place. On the other hand the fall in phosphate levels where no phosphate has been applied explains the few instances where responses were obtained in ratoons but not in plant cane. In another experiment phosphate applications failed to give a response in plant cane or in the first two ratoons but on replanting a significant increase in tons cane per acre was obtained due to phosphate applications.

POT EXPERIMENTS.

Phosphate Uptake.

Water soluble phosphate may be converted to tri-calcium phosphate, iron phosphate and aluminium phosphate and the availability of these phosphates to the sugarcane plant is therefore of considerable interest. For this reason a pot experiment was conducted using superphosphate, tri-calcium phosphate, ferric phosphate, aluminium phosphate and finally ground apatite as sources of phosphate in various quantities. The cane plants were harvested periodically and analysed so that the composition and weight of phosphates taken up could be calculated. The percentage phosphate composition on a dry weight basis of the whole cane plant at six months of age is given in the following table. The total phosphate application here given equalled 150 lbs. P_2O_5 per acre.

Table VIII

	Per cent P_2O_5 (Dry Wt. Basis)
Control	0.16
Superphosphate	0.50
Tri-calcium phosphate	0.26
Aluminium phosphate	0.36
Ferric phosphate	0.19
Apatite	0.22

As was expected the availability of superphosphate is by far the best and the least available phosphates are those from ferric phosphate and apatite. The availability of aluminium phosphate is however surprisingly high and where water soluble phosphate is converted to aluminium phosphate it still apparently remains fairly available to the sugarcane plant. Much the same picture emerges for different quantities of phosphatic fertilizers except that for larger applications the availability of phosphate from tri-calcium phosphate exceeds that from aluminium phosphate.

Nitrogen, Potash, Calcium and Magnesium Pot Tests.

In a pot test conducted in a soil low in potash and magnesium, different forms of nitrogen were used in combination with liming and the addition of magnesium and potassium. Both potash and nitrogen gave excellent yield responses and stimulated tiller formation, and magnesium also gave a yield response. There did not appear to be much difference in the effectiveness of nitrogen from the following sources : urea, ammonium sulphate, ammonium nitrate, and sodium nitrate on the grey Recent Sand used in this pot test.

Magnesium and calcium concentrations in the plants were markedly depressed by potash applications. Potassium concentration was slightly lowered by magnesium applications but not by liming. The nitrogen uptake was under all circumstances somewhat poorer from urea than from ammonium sulphate.

The Effect of cane sett composition on germination and growth.

A pot test was planted using single eyed 8 - 10 nodes from a 5N x 5K experiment where N and K_2O increments were 100 lbs. per acre each from 0 - 400 lbs. N or K_2O per acre. The original field experiment showed an excellent response to both nitrogen and potash and it was thought of interest to examine the effect of the nitrogen and potash composition on subsequent germination and growth. The 8 - 10 internodal composition, expressed on per cent. dry weight, was found to be as follows :

Table IX

Treatment	lbs. per acre	Per cent N	Per cent P_2O_5	Per cent K_2O
N0	0 N	0.23	0.13	0.51
N1	100 N	0.25	0.11	0.41
N2	200 N	0.44	0.10	0.51
N3	300 N	0.49	0.09	0.37
N4	400 N	0.59	0.09	0.44
K0	0 K	0.38	0.11	0.17
K1	100 K_2O	0.38	0.10	0.32
K2	200 K_2O	O.41	0.10	0.46
K3	300 K_2O	0.45	0.10	0.71
K4	400 K_2O	0.38	0.10	0.60

Forty setts were planted per treatment on the 23rd December without any addition of fertilizers and the germination counts were as follows :

Table X

	4/1/61	11/1/61	18/1/61
N0	9	24	34
N1	14	29	32
N2	30	38	39
N3	40	40	40
N4	40	40	40
K0	23	35	37
K1	26	30	34
K2	29	35	36
K3	27	36	38
K4	26	35	40

A high nitrogen content of the setts or the application of high amounts of nitrogen to the plant material, speeded up the rate of germination and ensured a better final stand.

Periodic growth measurements were taken and the average length in inches per germinated stool on the 25th January, 1961, was as follows :

Table XI

N0	1.86	K0	1.84
N1	2.81	K1	3.15
N2	3.35	K2	3.37
N3	4.03	K3	3.51
N4	5.17	K4	3.36

The increased length of shoots with increased nitrogen content of sett may be partly the result of earlier germination but this explanation does not hold for the potash series. The shoots from the setts taken from the potash control plot i.e. K0 were also later found to be weak and sometimes died out.

At a later stage half the pots were top dressed with a solution containing the equivalent of 300 lbs. per acre N, P_2O_5 and K_2O and all pots were finally harvested on the 23rd of March 1961 with the following results expressed as grams total dry weight per treatment.

Table XII

	Not Fertilized	Fertilized		Not Fertilized	Fertilized
N0	9.2	35.4	K0	11.2	31.6
N1	11.4	38.5	K1	12.8	42.8
N2	16.5	46.0	K2	12.9	50.5
N3	14.7	58.2	K3	16.7	48.9
N4	17.6	46.6	K4	15.9	50.1

These results seem to indicate that the nutritional status of the planting material may have an appreciable influence on the germination and growth of the subsequent crop.

LEACHING STUDIES AND UREA CONVERSION.

Now that urea has become one of the main nitrogenous fertilizer in South Africa, the volatilisation and leaching losses occurring as a result of the application of this type of fertilizer become of interest. Volatilisation losses will be reported elsewhere in this report. A study of leaching losses through a one foot soil column was made and it was found that the losses of nitrogen in urea freshly applied to the soil were comparable to the losses of sodium nitrate and far in excess of that from ammonium sulphate. Thus in one experiment after leaching with the equivalent of 9 inches of rain the percentages nitrogen lost were :

	Percentage loss
For Urea	99
Sodium nitrate	97
Ammonium sulphate	29

When however the urea was left in the wet soil for a few days before leaching the losses were greatly reduced.

	Percentage loss
After 0 days	83
After 2 days	23
After 4 days	5
After 7 days	3

Obviously the ammonium carbonate formed from the urea must greatly resist leaching. After a few days in contact with the wet Table Mountain sandstone soil the nitrogen losses from the originally applied urea were actually less than from ammonium sulphate and after a week the losses were negligible. The effect of the anion on the leaching of the cation was studied for both ammonium and potassium soils.

Table XIII

	Percentage K_2O losses where the Potassium salt was used	Percentage N losses where the Ammonium salt was used
Sulphate	32	34
Phosphate	13	14
Chloride	24	34
Carbonate	2	3

It is clear from these results that after seven days the conversion of urea into ammonium carbonate was complete and the nitrogen losses were then identical with those obtained when pure ammonium carbonate was used. With the leaching losses of urea and its first conversion product ammonium carbonate established and compared with other sources of nitrogen, it was decided to leave the fertilizer in contact with the wet soil in the columns for a longer period for nitration to proceed in the Table Mountain sandstone.

The equivalent of 200 lbs. N. per acre i.e. 24 mg. of N per column as also used in the other experiments were added in the form of urea and ammonium sulphate and left for three weeks after watering. At that stage the soils were leached and nitrate and ammonia determined in the leachates. One column containing urea was leached for the first time after five weeks; but a similar column with ammonium sulphate had to be abandoned as the water failed to penetrate the soil. Six weeks after fertilizer application the soils were again leached. The results are given in the following table :—

Table XIV

Treatment Leached after	Control 0 days	Control 3 weeks	A.S. 3 weeks	Urea 3 weeks	Urea 5 weeks
mg.N as NH_3	2.40	3.91	11.39	4.67	6.25
mg.N as NO_3	0.18	0.67	1.53	0.89	8.85
Total N	2.58	4.58	12.92	5.56	15.10
Leached after a further		3 weeks	3 weeks	3 weeks	1 week
mg.N as NH_3	—	1.88	4.29	4.86	5.11
mg.N as NO_3	—	4.05	9.20	19.06	4.59
Total N	—	5.93	13.49	23.92	9.70
Grand Total N	2.58	10.51	26.41	29.48	24.80

From these results the following may be concluded :—

(1) Nitration is tremendously stimulated if an unfertilized soil is wetted.

(2) Nitration during the first three weeks, even where urea or ammonium sulphate had been added, is slow but nitration thereafter is fast and at the end of five or six weeks large amounts of nitrates were found in the leachate.

(3) Although possibly slower to start with, nitration of urea later on proceeded much faster than ammonium sulphate in this somewhat acid sandy soil.

On completion of these tests the soils were submitted for a microbiological examination. Azotobacter was absent and apparently no aerobic fixation of nitrogen took place. On the other hand there was a decided possibility of anaerobic nitrogen fixation. Anaerobic counts showed an increase of free living organisms from a few thousand in the upper two inches of the soil column to a few million at the eighth to tenth inch layers.

It may also be mentioned that moisture and possibly also nitrogenous fertilizers stimulated aerobic bacterial populations. The total fungi-flora count showed no effect from wetting or ammonium sulphate addition but a very sharp increase due to the application of urea.

FERTILIZERS USED IN THE INDUSTRY.

Crop restriction as a result of over-production has had a drastic effect on fertilizer usage during the year 1960. From 1951 to 1959 the amount of potash used in the Industry has increased spectacularly every year and the same applies for nitrogen with the exception of one year when a very slight fall compared with the previous year was recorded. Although the general tendency was for phosphates to fall somewhat, a good increase was recorded during 1958 and 1959. During 1960, however, for the first time since 1951, the amounts of all fertilizer used have dropped sharply. The trends of fertilizer usage since 1951 are illustrated in Figure II (see page 20) and further details are given in table XV and XVI.

Table XV

	1951	1954	1957	1959	1960
Tons mixed fertilizer	25,277	34,431	23,412	33,805	23,653
Tons nitrogenous fertilizer	5,280	13,370	19,381	25,879	16,404
Tons phosphatic fertilizer	15,297	12,210	8,099	17,419	15,959
Tons potassic fertilizer	125	2,214	8,746	15,930	8,994
Total tons N	2,135	4,516	6,875	11,324	7,344
Total tons P_2O_5	6,526	6,004	3,415	5,980	4,365
Total tons K_2O	842	2,813	7,389	12,721	7,810

Table XVI

	1951	1954	1957	1959	1960
Total tons of cane	4,805,249	7,374,241	8,594,618	9,123,396	8,649,617
lbs. N per ton of cane	0.89	1.22	1.60	2.48	1.70
lbs. P_2O_5 per ton of cane	2.72	1.63	0.79	1.31	1.01
lbs. K_2O per ton of cane	0.35	0.76	1.72	2.79	1.81

Compared with 1959 the fertilizer usage during 1960 fell by about 35 per cent., but this reduction had nothing to do with the lower amount of cane produced during the latter year and in fact it may only show up two years later i.e. in 1962, for sugarcane in South Africa is in the main a two-year crop. The reason for the reduction in fertilizer consumption is economic and understandable with over-production. It is very likely that an even greater fall may be recorded during 1961. These reductions are bound to affect yields in a few years' time and unless acreages are also reduced there must be a danger of a fall in efficiency and even uneconomic production at too low a rate of fertilization.

FIGURE I

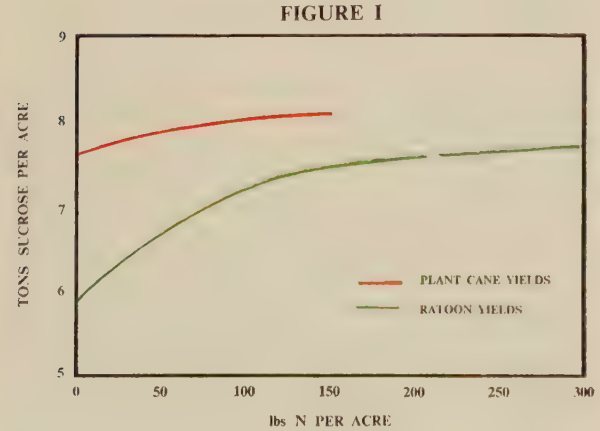
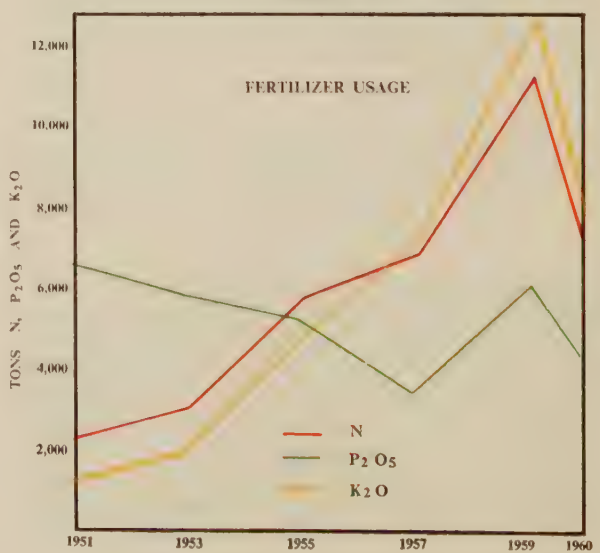


FIGURE II



Microbiology

Microbiologist : J. R. ANDERSON

AS a part of the research programme on soil nitrogen, urea hydrolysis and volatilisation studies have been made during the past twelve months. A method was devised for the measurement of volatilisation losses from nitrogenous fertilizers and has provided useful information on urea and the ability of soils to convert urea to ammonia. Since it was found that the greatest losses of ammoniacal - N occurred in sandy soils with low clay content and base exchange qualities, the majority of experiments were conducted on a red Recent Sand at two pH levels (5.3 and 8.5). Moisture, temperature, pH and the presence of trash were found to be the major factors aggravating volatilisation losses, and the following tables show the effects of these factors, singly and in combination, on the potential of a soil to lose ammoniacal - N.

Table I

Effect of moisture on volatilisation of ammonia from a Table Mountain sandstone (pH 5.3) receiving the equivalent of 200 lbs./acre urea.

Percentage moisture in sand †	*Percentage loss of ammonia **
Air dry (± 2%)	Nil
5%	2.5%
7%	3.1%
10%	7.5%
15%	1.0%
20%	0.7%

† maximum water holding capacity of sand = 25%
** after three days at 20°C ± 3°C*

The overall effect of moisture in sandy soils was to increase the loss of ammonia up to a point corresponding to approximately half the maximum water holding capacity whereafter the losses were decidedly lower, probably due to re-absorption of the ammonia in the excess moisture. The effect varied for different soil-types but the losses were often at a maximum at approximately 7% moisture, with no detectable losses occurring at less than 2% moisture. Losses of ammonia from sandy soils may become accentuated if drying-out of the soil occurs fairly rapidly.

Temperature, in accordance with the theory of accelerated enzymic action at increasing temperatures, was found to have its maximum effect at 37°C, and to decline rapidly above 50°C, as shown in Table II.

Table II

Effect of temperature on ammonia volatilisation from a red Recent Sand† (pH 5.3) receiving the equivalent of 200 lbs. per acre urea (moisture percentage = 7%).

Temperature (°C)	*Percentage loss as ammonia**
Ambient (20° ± 3°)	1.5 %
30°	2.0 %
37°	20.3 %
40°	19.8 %
47°	11.6 %
50°	12.0 %
57°	1.5 %
60°	0.85%
67°	0.3 %

† Maximum water holding capacity of soil = 24%
** After 48 hours.*

The optimum temperature for the urease enzyme is approximately 37°C, a temperature which, under field conditions, is easily attainable albeit for no great length of time.

Great emphasis has been laid on the effects of soil pH on volatilisation and, while the results obtained were in general agreement with this, it was found that pH in sandy soils is of lesser importance than in soils possessing significant clay contents and base-exchange abilities. The fact that ammonia, formed from urea, will rapidly raise the pH to above pH 7.0, probably accounts for the fact that the losses found at pH 5.3 and 8.5 did not differ greatly, as shown in Table III.

Table III

Effect of moisture and pH on volatilisation of ammonia from red Recent Sand receiving the equivalent of 200 lbs. per acre urea.

Percentage moisture in soil	*Percentage loss as ammonia**	
	pH 5.3	*pH 8.5*
Air dried (± 2%)	Nil	Nil
5%	21.5%	26.8%
12.4%	30.0%	34.0%
17.0%	9.3%	9.3%

** After seven days at ambient (20°C ± 3°C).*

The effect of initial soil pH is of the order of a 4% increased loss at the alkaline range, in spite of the great initial difference in pH of the two soils.

Greater response to soil pH was obtained, however, in an experiment designed to compare three forms of nitrogenous fertilizer on a red Recent sand at two pH levels.

Table IV

Per cent volatilisation of ammoniacal—N from red Recent Sands receiving three forms of nitrogenous fertilizer. (20°C ± 3°C).

	*Sand pH 5.3**		*Sand pH 8.5*	
	Not trashed		*Not trashed*	
N-Form	*1st Week*	*2nd Week*	*1st Week*	*2nd Week*
Urea	21.9%	24.5%	27.3%	27.4%
A.S.	0.8%	0.8%	19.0%	19.0%
A.N.	Nil	Nil	4.0%	4.3%
	Trashed†		Trashed†	
	1st Week	*2nd Week*	*1st Week*	*2nd Week*
Urea	20.0%	29.1%	45.6%	64.6%
A.S.	0.8%	1.4%	3.5%	4.9%
A.N.	Nil	0.5%	Nil	1.9%

* *Sand at 7% moisture.*

† *Slightly damp trash blanket 3" deep.*

Urea = equivalent of 200 lbs./acre.

A.S. = Ammonium sulphate, equivalent of 500 lbs./acre.

A.N. = Ammonium nitrate, equivalent of 350 lbs./acre.

Thus pH is of significance not only in urea applications, but for any ammoniacal fertilizer form. The loss from ammonium nitrate is of little consequence in the above case, but losses of N from this form of fertilizer are known to occur in other ways, notably by denitrification.

Trash gave high volatilisation losses in most cases and was extremely variable in this respect, ranging from 20% to 70% loss, a fluctuation probably due to degree of wetness and state of decomposition of the trash. The degree of wetness acts in a similar manner to moisture in the soil (Table I) and again the depressing effect on loss was encountered at high moisture (saturated) levels as shown in Table V.

Table V

Effect of trash (over red Recent Sands) at various degrees of wetness.

Treatment	*Percentage loss as ammonia**	
	pH 5.3	*pH 8.5*
Sand only†	21.07%	26.2%
Sand plus damp trash	35.7 %	34.0%
Sand plus saturated trash	8.0 %	9.0%

* *after seven days at 20°C (± 3°C).*

† *7% moisture.*

Urea equivalent to 200 lbs. per acre.

At the highest level of wetness, the excess moisture probably re-absorbed the ammonia, a factor which undoubtedly results in heavy losses upon drying-out of the trash.

The daily rate of loss of ammonia from a sandy soil was investigated and it was found that the sharpest rise occurs between the third to the fifth days as will be seen from the following table.

Table VI

Daily loss of ammonia from a red Recent Sand (pH 5.3) of 7% moisture content and receiving the equivalent of 200 lbs./acre urea. (20°C ± 3°C).

Days	*Percentage loss as ammonia*
1	1.0%
2	5.5%
3	9.5%
4	17.0%
5	22.1%
6	25.8%
7	31.3%
8	37.2%
9	39.6%
10	41.7%
11	42.3%

Replications, of which the above are average, vary within 10%. In general, it may be said that in sandy soils high losses may be expected from a urea application after rain with no further precipitation occurring for seven days. The advent of rain in the interval betweeen application and the tenth day will reduce the losses and the more rainfall the better the chances of the ammonia being carried deeper into the soil. A series of seven soils were studied in respect of their daily losses, the result being presented in Table VII.

Table VII

Daily loss of ammonia from seven soil-types each at one-third moisture holding capacity and receiving the equivalent of 200 lbs. per acre urea. (20°C ± 3°C).

Soil	*ph*	*Daily percentage loss as ammonia*										
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Table Mountain sandstone	5.3	0	3.5	9.2	16.1	18.3	19.6	21.0	22.0	23.9	23.9	23.9
Schist	5.3	0	0.09	1.4	1.9	4.3	5.3	5.8	7.0	8.6	9.0	9.4
Black dolerite ...	5.4	0	0	0	0	0	0	0	0	0	0	0
Lower Ecca	5.4	0	0.08	1.3	1.6	2.5	2.6	2.6	2.6	4.3	4.3	4.5
Grey Recent Sand	6.8	0.01	7.6	15.1	23.6	30.0	35.7	40.8	47.4	50.8	55.1	56.2
Middle Ecca	7.7	0	1.2	1.5	2.4	4.3	5.2	6.1	8.0	8.4	8.7	9.0
Alluvium	7.8	0	1.5	3.1	3.7	5.3	5.8	6.5	7.9	8.8	9.0	9.2

It is apparent from these results that the percentage clay and the base exchange capacity of the soil is very highly significant, with pH playing a more important role in the heavier soils than in the sandy soils (see also Table 6).

The effect of urea application in the presence and absence of a growing plant was examined employing the variety N:Co.310 grown in red Recent Sand in glass tubes two and one half inches in diameter by twenty four inches deep. The equivalent of 200 lbs. per acre urea was applied and the experiment allowed to run for fourteen days at room temperatures, in the presence of sunlight. The urea was applied to the tubes containing the plant when the latter was approximately six inches tall. No difference was detectable in the amount of volatilised ammonia, both the tubes plus plants and the tubes without plants recording a total of seventeen per cent loss on the fourteenth day. Another replication of the above received a total of one inch of rain over the entire fourteen day test period and the losses in this case were reduced to six per cent in both cases.

The major soil groups were examined for their ability to convert urea to ammoniacal-N, regardless of their ability to retain ammonia. The technique employed was a modified version of the Strojanovic (1959) method. The results, presented in Table 8, should in no way be compared with volatilisation losses since, in this case, the equivalent of urea applied was approximately 9 tons per acre in addition to which the small amount of soil and the large amount of urea solution plus buffer solution, created conditions which are not comparable to conditions favouring volatilisation. The apparently low per cent conversion in some cases is considered to be adequate for the formation of ammonia under field conditions.

Table VIII

Urea hydrolysing Index of various soils incubated at 37.5°C for 96 hours.*

Soil	*Percentage conversion (urea to ammonia)*
Black dolerite	99.0 %
Lower Ecca	94.0 %
Dwyka	89.7 %
Alluvium	60.5 %
Table Mountain sandstone (mist belt)	59.2 %
Red Recent Sand (Alkaline)	44.3 %
Red dolerite	40.3 %
Schist	28.2 %
Red Recent Sand (acid)	17.3 %
Table Mountain sandstone (ordinary)	17.25%
Middle Ecca	15.5 %
Grey Recent Sand	2.86%

* *Receiving 10 mls. buffer (pH 6.8) and 10 mls. 0.2% urea per gram air dried soil.*

This ability index, as mentioned, cannot be directly compared to volatilisation losses and neither can it be translated immediately into practical field information. It remains an index whereby doubts as to the ability of a soil to produce urease enzyme may be dispelled.

The enzyme is produced by several forms of micro-organisms which are referred to as ureolytic organisms. Seven such organisms were isolated from red Recent Sand, Table Mountain

sandstone and black dolerite soils. The most common in all the soils investigated conformed to *Bacillus pasteuri* (2) and *B. sphaericus* type (3), *B. lentus* — like (1) and *Sarcina ureae* — like (1) organisms made up the balance.

In the glass tubes utilised for volatilisation studies in the presence of the growing plant, bacilli of the *pasteuri* and *lentus* type were found to be present in large numbers down to a depth of four inches whereafter the numbers decreased rapidly.

In another red Recent Sand the population of bacteria isolated by urea enrichment techniques consisted almost exclusively of gram positive bacilli, the majority of which were spore-formers. It was thought that air drying and the application of urea to the soil soon afterwards acted as an enrichment technique in itself and hence is not a true reflection of natural soil ability to split urea and lose ammonia by volatilisation. In another experiment it was found that fresh field soil (not air dried) generally showed a reduced loss of ammonia by volatilisation. Thus, fresh soil and air dried soil were compared with fresh soil which had been steam sterilised for 4 hours at 100°C.

The steamed soil (moisture adjusted to 5%), when introduced into the volatilisation system showed a considerable lag-phase (48 hours) whereafter a total of 46% loss of ammonia was recorded. The airdried soil showed a 31% loss for a comparable length of time (excluding lag phase) and the fresh soil showed a loss of 27.6% in the same time.

It was concluded that air drying and steaming favour the survival of spore-forming organisms, many of which are ureolytic forms, whereas fresh soil possesses a natural indigenous flora which is composed of ureolytic and non-ureolytic, but nitrogen requiring, organisms. The presence of the latter group in the fresh soil probably accounts in part for the reduced losses by virtue of the demand they make on the ammonia formed. Under field conditions, therefore, the losses of ammonia presented in the foregoing paragraphs are comparable at a reduced level of about 10% of the value given.

Trash was found to possess a large population of bacteria, fungi and actinomycetes and the presence of at least two species of bacilli capable of high ureolytic activity make trash an extremely potent medium for the promotion of volatilisation losses. The two bacilli were thought to belong to the genus *Proteus*. Numerous *Micrococci* were also isolated and found to posses ureolytic qualities.

Finally, the rate of conversion at room temperature of urea to ammonia and thence to nitrate was studied in a modified Lees perfusion apparatus. The equivalent of 200 lbs. urea per acre was found to hydrolyse fairly slowly, 90% being converted in a Table Mountain sandstone (pH 5.6) in fourteen days. The equivalent of this amount of ammonia was added to the same soil sample after rinsing with distilled water. The conversion rate to nitrate was found to be extremely slow with a high percentage of nitrate predominating, probably due to inhibition of *Nicrobacter spp* by ammonia ions in the confines of the closed perfusion system.

Cultural Practices

Chief Agricultural Officer : C. H. O. PEARSON

THE evapo-transpiration tanks installed under irrigation and planted to cane in 1959 were harvested as twelve month old plant cane during the current season. This experiment was replicated at two other sites in co-operation with the Tongaat Sugar Company and the Illovo Sugar Estates Limited.

The consumptive use of water calculated by taking the total rainfall together with the amount of irrigation water applied, and deducting the leachate collected from the 1/1000th acre tanks is illustrated in Figure I.

The mean yields of the twelve month old plant cane crop together with other relevant data are given in Table I.

The mean consumptive use for all three centres in the plant cane crop was 109% of the evaporation from a Standard British evaporation tank.

Of perhaps even greater interest however was the range of F values recorded during the crop. These are shown in Table II for all three stations.

FIGURE I

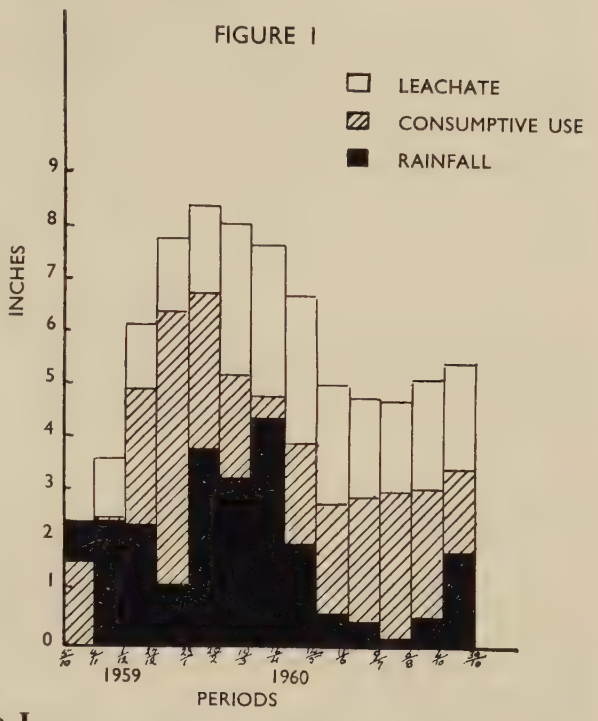


Table I

	tca	tsa	Rainfall in.	Irrigation in.	Total water in.	Leachate in.	Consumptive use in acre in.	Open tank Evaporation in.	F *
Chakas Kraal	61.61	7.97	26.23	50.87	77.09	23.12	53.97	46.63	1.15
Tongaat	58.69	6.66	23.25	49.33	72.58	23.43	49.08	45.83	1.06
Illovo	55.84	6.62	24.80	46.24	71.01	28.42	42.80	46.32	0.93
Mean	58.94	7.08	24.74	49.55	74.29	24.01	50.28	46.26	1.09

$$* F = \frac{\text{Consumptive use}}{\text{Evaporation}}$$

Table II

DATE	CHAKA'S KRAAL			TONGAAT			ILLOVO			MEAN		
	Con. Use	Evap-oration	F.	Con. Use	Evap-oration	F.	Con. Use	Evap-oration	F.	Con. Use	Evap-oration	F.
Oct. 5—Nov. 4	1.72	4.86	0.35	0.85	3.83	0.22	2.22	4.57	0.49	1.59	4.42	0.35
Nov. 5—Dec. 1	2.43	3.84	0.63	1.97	4.29	0.46	3.56	3.88	0.92	2.65	4.00	0.67
Dec. 2—Dec. 27	5.04	4.68	1.08	5.70	4.61	1.24	3.59	5.00	0.72	4.77	4.76	1.01
Dec. 28—Jan. 23	6.28	4.91	1.28	6.14	5.65	1.09	6.48	5.33	1.22	6.30	5.29	1.19
Jan. 24—Feb. 20	7.41	4.95	1.50	6.54	5.26	1.26	5.91	4.18	1.41	6.62	4.79	1.39
Feb. 21—Mar. 19	6.85	4.47	1.53	5.41	4.77	1.13	3.11	4.41	0.71	5.12	4.55	1.12
Mar. 20 — April 16	5.12	3.92	1.31	4.34	3.10	1.40	4.97	3.54	1.40	4.81	3.52	1.37
April 17—May 14	3.84	2.55	1.51	4.34	3.10	1.40	2.81	2.16	1.30	3.66	2.60	1.40
May 15—June 11	2.88	2.39	1.21	3.08	2.19	1.41	2.20	2.52	0.87	2.72	2.36	1.16
June 12—July 9	3.15	2.02	1.56	2.28	1.81	1.26	2.76	1.95	1.42	2.73	1.92	1.41
July 10—Aug. 6	3.33	2.58	1.29	2.72	2.68	1.29	2.48	2.68	0.93	2.84	2.45	1.16
Aug. 7—Sept. 3	3.61	2.33	1.55	2.69	2.26	1.19	2.48	2.68	0.93	2.93	2.42	1.22
Sept. 4—Sept. 30	4.84	3.13	1.55	3.47	3.37	1.03	1.89	2.93	0.65	3.40	3.14	1.08

The period up to the end of December represents the stage of crop establishment up to the time of closing in of the lines, during which period evaporation from the soil surface is the major factor involved in moisture loss. Thereafter with the crop closed in, transpiration by the crop is the major factor involved. During this latter period the consumptive use was 139.7% of the evaporation from a standard tank.

It would appear from the foregoing that about 0.85 inch of water is required to produce 1 ton of cane and also that with the correct use of irrigation, large tonnages of cane can be grown without depressing the sucrose per cent cane to any significant degree.

IRRIGATION AND YIELDS.

In the trial planted at Chaka's Kraal in 1951 to obtain some comparative yield data from areas of cane grown under spray irrigation, furrow irrigation, and under normal climatic conditions, the irrigated plots have been cut for the seventh time as a 6th ratoon crop. The yields given in Table III are those obtained over a 9 year period.

Table III

	Yields in tons cane per acre for each crop harvested.								
Treatments	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*
Furrow Irrigation	36.11	38.93	—	62.61	47.66	36.95	—	60.03	66.69
Spray Irrigation	50.13	58.39	—	70.32	56.57	53.30	—	60.40	76.04
Dryland	—	56.47	—	55.97	—	69.02	—	59.92	48.42
				Accumulated Totals					
Furrow Irrigation		75.04		137.65	185.31	222.26		282.29	348.98
Spray Irrigation		108.52		178.84	234.41	288.71		349.11	425.15
Dryland		—		112.44		181.46		241.38	289.98

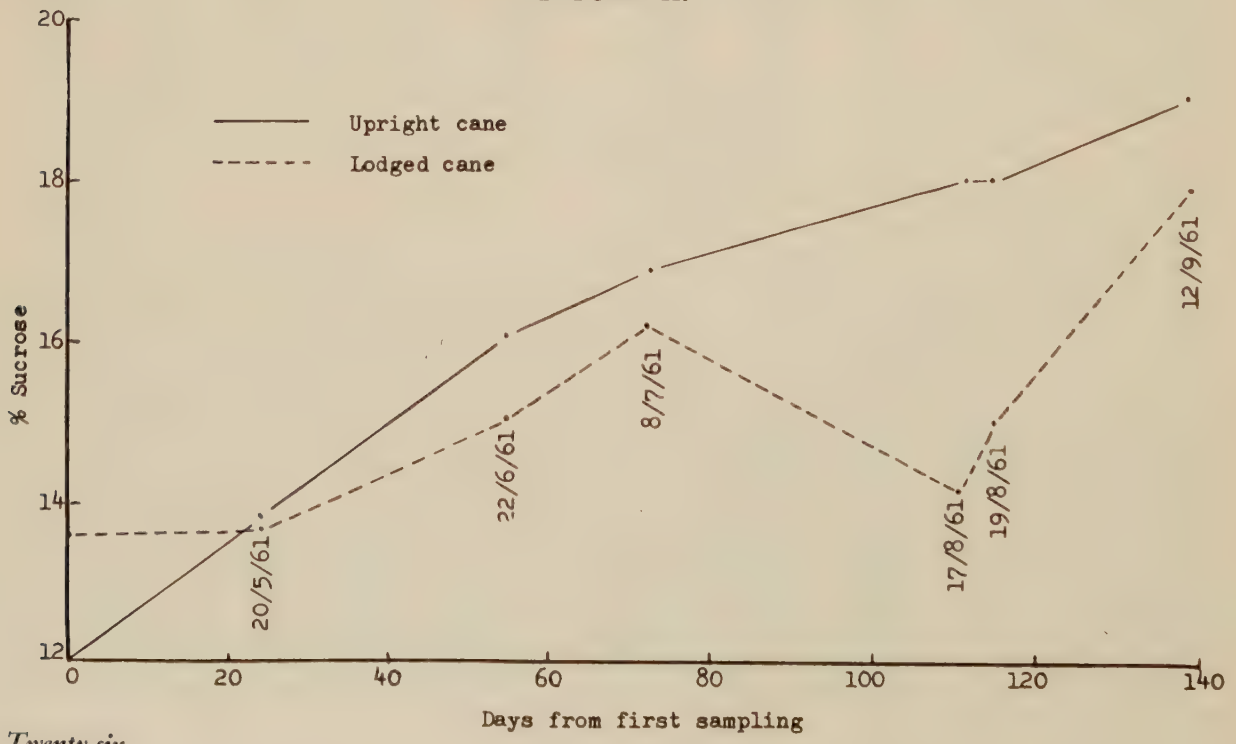
In years of good rain, such as 1959, the benefit from irrigation was hardly noticeable. However from the accumulated totals it can be seen that there are, over the 9 years, increases in yield of the following order :

Tons cane	289.98	348.98	425.15
Per cent increase		20.3	46.6

From observations carried out in this experiment it appeared that there was a drop in both yield and in sucrose per cent. cane as a result of cane lodging. In order to test this an area of the spray-irrigated cane was supported by erecting a grid of bamboo poles. The surrounding cane was allowed to lodge in the normal way but at the first sign of lodging samples were taken from both areas and sucrose analysis was carried out on each.

Figure II gives the relative sucrose content of samples taken between April 26th and September 12th 1960 when the cane was cut for the mill.

FIGURE II.



The drop in sucrose which became apparent on 17th August, was confirmed by resampling on 19th August. The drop in sucrose which was recorded at this period coincided with the upward trend in the mean daily temperatures. Usually with the rise of temperature in spring, growth recommences and the formation of bull shoots in the lodged cane may account for the sudden drop in sucrose from the mature stick.

SPACING TRIALS.

The spacing, variety, fertilizer trial planted under irrigation in December 1959, notes on the germination of which were given in the Annual Report for 1959-60, suffered unforseen complications due to the phenomenal response to irrigation shown by the variety "Salvo" (N.50/211). This variety, which had not previously been tested under irrigation, outgrew the other two varieties N:Co.334 and N:Co.376 included in the trial to such an extent that at the age of 11 months it was already lodging while the other two had still to produce millable sticks. The Salvo plots were cut in December 1961 at 12 months of age with the results shown in Table IV.

Table IV

Spacings	*tca*	*Sucrose % cane*	*tsa*	*Inches water per 1 ton cane*
S1. rows 1′ 6″ apart	57.15	11.99	6.84	0.86
S2. rows 3′ 0″ apart	52.37	11.52	6.03	0.94
S3. rows 4′ 6″ apart	49.75	11.01	5.49	0.99
Fertilizer				
F0. Nil	51.87	11.66	6.06	
F1. 200 N, 150 P_2O_5, 200 K_2O	54.10	11.63	6.31	
F2. 400 N, 300 P_2O_5, 300 K_2O	53.30	11.23	5.98	

S.E. % G.M. 6.80
3.70 at P = 0.05
5.19 at P = 0.01

Rainfall on crop ..... 39.19 in.
Irrigation ..... 10.16 in.
Total water on crop ..... 49.35 in.

After deducting the additional requirements of seed cane for planting at the closer spacings the yields may be adjusted as follows :

4′ 6″ spacing 49.75 tca
3′ 0″ spacing 51.37 tca
1′ 6″ spacing 53.15 tca

These relatively small yield increments accruing from closer spacing were nevertheless accompanied by various side effects e.g. greatly reduced weed growth which could substantially increase the economic significance of closer spacing.

The data presented in Table V indicates that with closer spacing the sticks tend to become lighter, longer and more numerous.

Table V

Spacing	*Mean No. canes per plot*	*Mean Weight per can (lb.)*	*Length of cane in feet (%)* 3	4	5	6	7	8
1′ 6″	1326	1.61	1.1	5.2	17.7	36.2	30.2	6.9
3′ 0″	1167	1.86	2.5	7.7	27.1	45.3	16.5	0.9
4′ 6″	1083	1.90	2.5	11.9	36.0	37.0	11.2	0.7

The number of sticks per plot at maturity was much lower at the closer spacing than could have been anticipated from the original germination counts made in 1959 and reproduced here in Table VI.

It is not possible at this stage to state whether this was due to there being fewer sticks per stool or just fewer stools surviving to maturity at the closer spacings.

Table VI

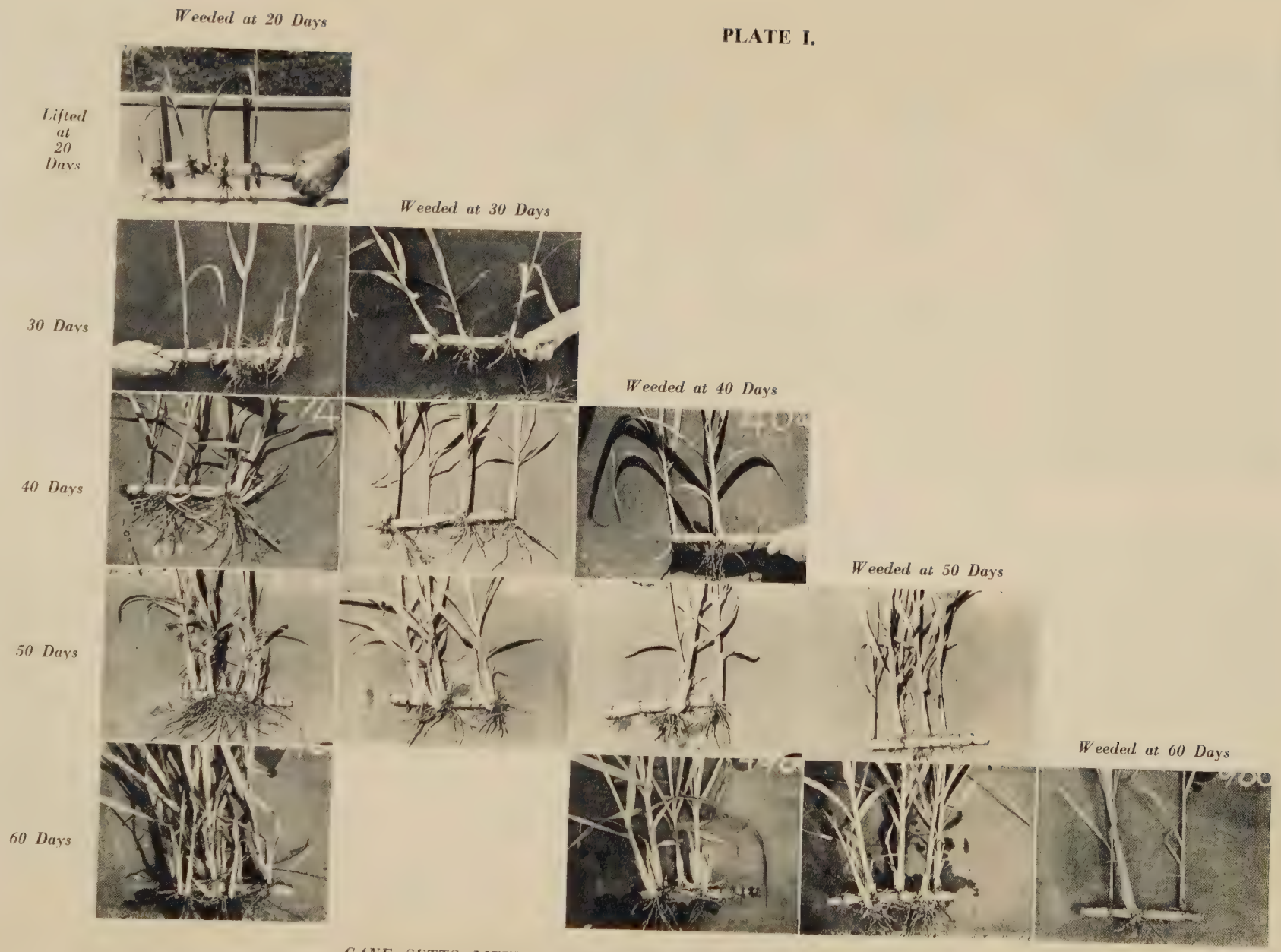
Mean number of shoots per line according to inter-row width

1′ 6″ inter-rows	41.6 shoots
3′ 0″ inter-rows	34.5 shoots
4′ 6″ inter-rows	31.4 shoots

WEEDS IN CANE.

Previous experiments have indicated that the presence of uncontrolled weed populations in plant cane can lower yields by as much as 35 tons cane per acre in comparison with that from a clean weeded crop.

PLATE I.



CANE SETTS LIFTED AFTER VARIOUS PERIODS OF WEED COMPETITION

Two experiments were harvested during the year which confirmed the magnitude of the effects of weeds on yields.

The treatments given and the yields obtained in these two experiments are summarised in Table VII below :—

Table VII

Treatments

T0 — No weeding.
T1 — Clean weeding in rows every 14 days. Inter-rows scuffled.
T2 — Clean weeding in rows every 28 days. Inter-rows scuffled.
T3 — Rows unweeded. Inter-rows scuffled.
T4 — Rows weeded once. Inter-rows scuffled.

Yields in tons cane per acre

Treatment	*Spring plant*	*Autumn plant*
T0	40.47	25.20
T1	62.88	54.95
T2	62.35	56.38
T3	54.96	34.46
T4	63.81	36.54
S.E. % G.M.	13.06	8.27
L.s.d. P = 0.05	6.42	8.99
P = 0.01	9.34	13.08

There were marked differences in the types of weed populations at the two times of planting. The weather patterns at and subsequent to planting also differed considerably, this probably accounting in large measure for the different responses to treatment T4 in the two experiments.

Following on these experiments, an observation plot was established in which sections of rows were weeded after 20, 30, 40, 50, and 60 days from planting date. Individual plants from each section were lifted immediately after weeding and thereafter at 10, 20, 30, 40, 50, and 60 day intervals.

Plate I illustrates the stages of development reached at weeding and after the various intervals elapsed thereafter.

In-row weeds would appear to retard stool development by inhibiting the formation of shoot roots and tillers.

COMPLEMENTARY CROPS.

Preliminary trials were conducted with a number of crops which appeared to be suitable for production in the cane belt. These included cotton, groundnuts, castor, lucerne and a number of pasture grasses.

With proper protection from pests and growing the appropriate disease resistant varieties it was apparent that cotton was likely to be one of the most reliable and profitable crops of those tested to date.

The work on this crop is being continued and will be reported on a a later date.

Table VIII summarises the trials in existence in the canebelt at the present time.

Table VIII

TRIALS IN EXISTENCE, SAMPLED AND HARVESTED IN THE CANE BELT DURING 1960-61.

TYPE OF TRIAL	R.F.T.		Exploratory Fert.		Fertilizer		Agronomic		Variety		Pest		Disease		No. of trials and Plots		Grand Total
Position and Supervision	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	Managed	Harvested	
	No. of Trials																
Zululand :	4	12	1	1	2	1	2	1	3	2	—	3	3	1	15	21	36
North Coast :	4	4	—	2	5	1	—	—	3	5	4	1	4	2	20	15	35
South Coast :	2	4	—	1	3	—	—	—	2	1	—	—	1	0	8	6	14
Mtunzini Propagation Farm :							—	2	5	7			0	0	5	9	14
Chaka's Kraal Exp. Farm :			—	1	2	1	4	9	—	4			1	0	7	15	22
Mt. Edgecombe Exp. Stn.:							1	2	2	1			8	2	11	5	16
Outside S.A.S.A. Observers :	3		1	1					2	0					6	1	7
Total Exp. in Groups :	33		8		15		21		37		8		22		72	72	144
Environment Sites.	Micro Lines		Micro Lines		Variety Trials												
Illovo Sugar Estates :																	
Powers Court	2				1												
Amanzimtoti	1				1												
Tongaat Sugar Co. Ltd :																	
Tongaat Section	2		1		1												
Umhlatuzi Valley Sugar Ests.	1		2														
S.A.S.A. Experimental Farm, Chaka's Kraal	2		1		1												

Cane Varieties

Plant Breeder : P. G. C. Brett

THE PRESENT VARIETY POSITION.

DURING the past season, the variety N:Co.310 once again comprised by far the major portion of the crop. During the 1957/58 season N:Co.310 provided 60.05 per cent of the total crop, but during the following season it showed a very slight decline. It was then thought that N:Co.310 had passed its peak and that, as happens with most varieties, it would decline with increasing rapidity until it began to approach the point of disappearance. As N:Co.310 formed 59.99 per cent of last season's crop, the expected trend has not been shown, in spite of the fact that N:Co.310 is known to have lost favour in some parts of the cane belt. The explanation appears to be that its declining popularity in the main cane belt has been offset by its more extensive cultivation in some of the newly-developed, and highly fertile areas, such as Pongola.

After N:Co.310, the next most important variety was Co.331, which comprised 12.85 per cent of the crop. Co.331 has been declining steadily over the last six years, and it is expected that next season it will be overtaken by the variety N:Co.376, which continues to increase rapidly in popularity and has now risen to 10.44 per cent of the total crop. On the other hand, not one of the varieties N:Co.292, N:Co.293 and N:Co.339, all of which were distributed before N:Co.376, has yet risen to 5 per cent of the total crop. However, N:Co.293 is very popular in certain areas, and at the Entumeni Mill, for example, 45 per cent of the cane crushed consisted of this variety.

N:Co.382 is proving popular in many areas, particularly as a replacement for Co.331, but it has not been in commercial cultivation long enough for it to have had an appreciable effect upon the composition of the crop.

To sum up, it may be said that future trends will probably consist in the expansion of N:Co.376 and N:Co.382, a continued and fairly rapid decline of Co.331, a less rapid decline of N:Co.310, and the virtual disappearance of Co.301. It is not expected that the varieties N:Co.292, N:Co.293 and N:Co.339 will ever prove major ones for the Industry as a whole.

The recently distributed variety Salvo (N.50/211) appears to be well liked by some, and may well find its place in the Industry, even though it may never become a major variety. Its tendency to put on height rapidly, which enables it to be harvested after a relatively short growth period, is not likely to be considered a partiacular advantage during the present period of restricted production.

PRE-RELEASE TRIALS.

No new varieties were distributed during the past season, but a new system is being tried out for the more thorough testing of promising varieties before a final decision is made as to whether they should be released or discarded. The procedure has been to supply seedcane sufficient to plant about a quarter of an acre to one representative of each planters' group, and to all miller-cum-planters. Companies to which agronomists are attached have used the material to plant replicated plot trials, while in all other instances observation plots have been laid down. The plant cane crop will be weighed and sucrose tested when harvested, and if these tests indicate that a variety is worthy of release, material from the year-old ratoons will be used for distribution. It is to be expected that these trials will greatly reduce the chance of overlooking a variety that is adapted to certain specialized conditions only.

Up to the present, four varieties have been planted in pre-release trials. The variety Saccharine (N.10) is derived from the cross N:Co.310 x Co.301. It has a high sucrose content but is generally not very vigorous. The varieties Saraband (N.51/168) and Sabre (N.51/539) are both derived from the cross Co.421 x Co.331. and the variety Salute (N.52/219) from the cross N.M.214 x N:Co.339. Present indications are that none of these varieties if released will ever become major ones, but they may have a limited use in certain parts of the cane belt.

The variety N.53/216 is intended for planting in pre-release trials during the coming season, and is being named "Samson".

VARIETY TRIAL RESULTS.

N.50 Series.

One trial with seedlings derived mostly from the N.50 Series was harvested during the year as second ratoons. This trial was situated on the South Coast granites. The following yields, in tons sucrose per acre, were obtained :—

N:Co.376	9.9
Salvo (N.50/211)	9.6
N.50/93	8.6
Co.331	7.7
Saccharine (N.10)	5.3

It will be seen that the recently distributed variety Salvo gave a fairly good yield, but that the variety Saccharine, at present in pre-release trials, proved very disappointing.

N.51 Series.

Five trials were harvested with seedlings of the N.51 Series—one as plant cane on alluvium, one as second ratoons on dwyka, and the remainder as first ratoons. The results are given below, the yield in terms of tons sucrose per acre being expressed as a percentage of that of N:Co.376.

SEEDLING	SOIL TYPE				
	Alluvium	Recent Sands	Mistbelt	Granites	Dwyka
N.51/101	75.5	95.8	77.9	102.1	101.0
N.51/168	78.1	103.5	78.2	104.8	80.2
N.51/201	66.7	73.7	33.5	72.7	74.4
N.51/249	69.1	101.3	60.3	64.8	67.5
N.51/377	74.5	49.2	33.9	56.1	61.9
N.51/502	77.9	81.5	75.9	82.9	87.8
N.51/524	71.3	76.3	33.7	85.8	82.7
N.51/539	71.1	119.0	56.0	98.3	94.7
N.51/669	71.1	56.9	72.0	74.2	87.4
N.51/783	82.5	94.2	82.4	82.5	103.1
Co.331	—	111.2	—	78.2	82.0
N:Co.293	—	—	88.8	—	—
N:Co.310	94.8	—	—	—	87.6

It will be seen that the two seedlings at present in pre-release trials, Saraband (N.51/168) and Sabre (N.51/539), showed reasonable performances on sands and granites, but did not prove promising elsewhere. Except on the recent sands, N:Co. 376 out-yielded other standard varieties included in these trials.

N.52 Series.

One trial with seedlings of the N.52 Series was harvested as first ratoons on alluvium. The results, in terms of tons sucrose per acre, are given below :

N:Co.376	11.9
N.52/219 (Salute)	11.2
N:Co.310	11.2
N.52/214	10.1
N.52/340	8.8
N.52/338	8.7
N.50/177	8.6
N.52/115	7.7
N.52/10	6.6

It will be seen that the variety Salute, at present in pre-release trials, gave a fairly good yield but that other seedlings showed little promise.

N.53 Series.

Four trials with seedlings of the N.53 Series were harvested during the season. One on Middle Ecca was harvested as first ratoons, the other three as plant cane. Results of these are given below in terms of tons sucrose per acre as a percentage of that of N:Co.376.

SEEDLING	SOIL TYPE			
	Mistbelt	Granites	Middle Ecca	Alluvium
N.53/82	82.1	84.5	67.1	85.3
N.53/87	84.1	96.6	67.5	82.8
N.53/216	102.7	104.5	87.5	97.2
N:Co.292	—	—	—	101.3
N:Co.293	111.2	—	—	—
N:Co.310	—	—	82.6	106.5
N:Co.339	—	94.7	—	—
N:Co.382	88.0	97.9	—	—

Of the three seedlings included in this series, N.53/216 is clearly the best. It is intended for pre-release trials during the coming season.

N.55 Series.

A trial with 26 seedlings of the N.55 Series, two introduced varieties, and two standard varieties was harvested as plant cane during the season. Yields of the introduced and standard varieties, together with the thirteen best seedlings, are given below in terms of tons sucrose per acre.

N.55/795	9.32
N.55/819	9.09
N.55/713	9.04
N.55/946	8.86
N.55/814	8.68
N.55/742	8.57
N.55/988	8.43
N.55/854	8.41
N.55/803	8.32
N.55/805	8.20
N:Co.376	8.11
N:Co.310	8.11
N.55/871	7.95
N.55/997	7.91
N.55/841	7.90
Co.462	7.51
Co.617	7.20

N.57 Series.

Fifteen seedlings of the N.57 Series were harvested as plant cane in an irrigated trial. Yields of the five best seedlings and the variety N:Co.310 are given below in tons sucrose per acre.

N.57/1917	7.60
N:Co.310	7.27
N.57/1987	7.23
N.57/1906	6.77
N.57/1899	6.69
N.57/1965	6.59

Introduced Varieties.

The following results, in terms of tons sucrose per acre, were obtained with a number of introduced varieties grown under irrigation.

C.B.36/14	10.84
C.B.38/22	10.38
Co.462	10.16
N:Co.310	9.66
C.B.38/29	9.54
C.B.45/47	9.19
Q.50	8.91
M.165/38	8.88
C.P.44/154	8.23
Co.360	8.04
Co.617	7.39
M.423/41	7.18

SEEDLINGS PLANTED INTO VARIETY TRIALS.

Seven seedlings of the N.55 Series, one of the N.57 Series (N.57/1917) and the introduced varieties C.B.36/14, C.B.38/22 and Co.462 were planted into secondary variety trials. The environment stations were used for these plantings.

Fifteen seedlings of the N.56 Series were planted into a primary variety trial with three replications.

From seedlings of the N.58 Series, 199 were selected for planting into two-plot trials. Of these, 45 were selected for irrigated conditions.

A second selection was made from introduced varieties in micro-plots and six were planted in observation plots, again under irrigation.

THE EARLIER STAGES OF SELECTION.

The development of the environment stations was taken a stage further by the planting of a second series of micro-lines. In all, 2,892 seedlings, selected from 18,847 single stools, were planted in this way. The actual number of seedlings planted as micro-lines at each of the environment stations was as follows : irrigated conditions, 578, high altitude region, 559; South Coast granites, 546; littoral region, 561; and delta areas, 648.

Seedlings of the N.59 Series in single lines were harvested during the year, being weighed and analysed for sucrose content at the time of harvest. They consisted of a total of 1,391 seedlings, of which 194 had been grown under irrigated conditions.

During the year, 1,981 seedlings were planted as single lines. Twenty-four of these had been selected originally from bunches, 594 were re-plants of seedlings from the previous year's selection that had germinated badly, and the remainder came from the normal selection of single stools. Of the latter, 213 were selected for adaptation to high altitude conditions and planted on the environment station for this region.

The numbers of seedlings taken from different crosses for planting in single lines and micro-lines are given in Appendix I.

SEEDLING RAISING.

From seed produced in 1959, about 55,000 seedlings were raised, and of these 46,499 were planted as single stools and about 7,000 in bunches. These seedlings were obtained from 221 female tassels. The numbers of seedlings obtained from the various crosses, of which 87 in all were used, are given in the appendix. Surplus seed was stored in the deep freeze, and sown together with some of the seed obtained in 1960, at the beginning of the present year. In all, from 298 tassels, about 57,000 seedlings were germinated, and of these about 46,000 were potted singly and about 10,000 in bunches.

During the 1960 flowering season 113 different crosses, involving 229 female tassels, were made. Of these, 104 tassels were used in the raising of seedlings mentioned above, and the remainder stored in the deep freeze. Work on the artificial induction of flowering by means of controlled photoperiods was continued, and a number of tassels obtained as a result were used in the making of crosses. Alterations and additions have been made to the glasshouse, and these should enhance its value considerably.

Cane Diseases

Plant Pathologist : G. M. THOMSON

MOSAIC DISEASE.

1. Mosaic and N : Co. 376.

DURING surveys carried out in the industry, it was repeatedly observed that where N:Co.376 became infected with mosaic disease, stalks showed a very pronounced stunting effect. This effect was less noticeable in other varieties.

In order to determine the effects of planting mosaic-infected seed cane on the germination and subsequent growth of N:Co.376 an experiment was planted in the greenhouse in which 80 single-budded setts derived from mosaic- infected stalks of N:Co.376 were planted in tins. Controls consisted of a similar number of setts taken from healthy N:Co.376 stalks.

Germination counts were taken at 2-day intervals for 2 weeks from the time the first shoots appeared above ground. From about the time when germination counts were discontinued stalk lengths were measured every week for the following 22 weeks.

A surprising feature of the germination results was that whereas the healthy setts gave a total of 76% germination the diseased setts germinated to the extent of 93%. This result bears further investigation.

When all the stalks were weighed at the end of the experiment it was found that the mean weight per stalk in the mosaic-infected cane was appreciably less than that of the healthy cane — 37.7 g. as compared with 48.4 g.

Referring to the accompanying graph (Fig. 1) it will be seen that the rates of growth of diseased and healthy cane follow very much the same course for the first six weeks but then the curves diverge until at the end of the experiment the mean length of diseased stalks was only 86% that of the healthy stalks.

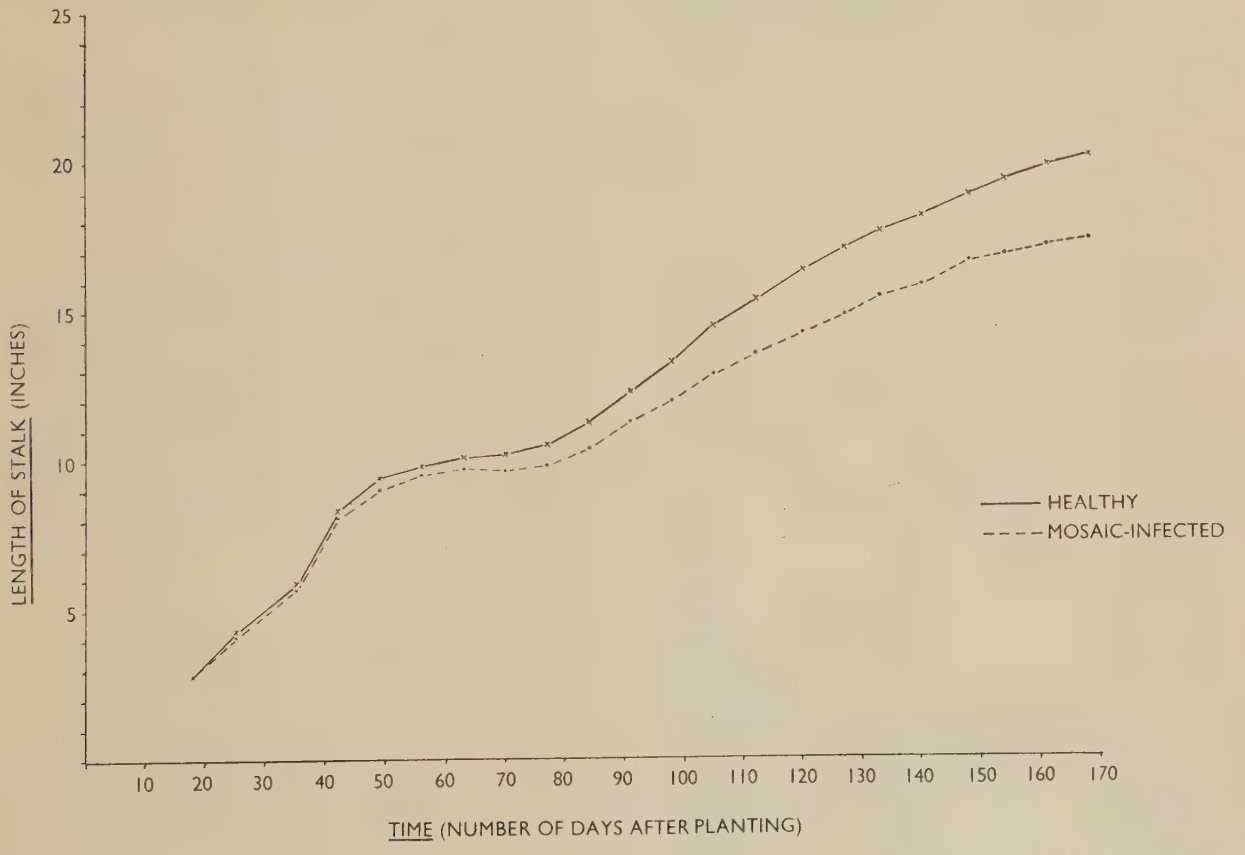


FIGURE 1. COMPARATIVE RATES OF GROWTH OF HEALTHY AND MOSAIC-INFECTED N:Co 376

2. Mosaic Resistance Trials.

Final assessments have now been made of the N.55 series of seedlings in the resistance trial partially reported last year.

Although none of the seedlings survived the trial without becoming infected, partially at least, N:Co.382 and C.B.36/14 escaped infection (see Table I). Eight varieties showed only one stool infected out of a total possible of 24 stools.

The large increases in percentage infection in the ratoon crop in some varieties show the need for continuing these trials into the ratoon and not making assessments on plant cane results alone.

It is interesting to note the large ratoon increases in mosaic infection in M.423/41, Q.50, N:Co.334 and N:Co.339. Furthermore the instances of apparent recovery in N:Co.292 and N:Co.310 and of partial recovery in C.B.45/27 are worth noting. This phenomenon has been recorded before in N:Co.310 and is suspected to have occurred in N:Co.292 on occasions.

The plant cane crop of the N.54/N.56 resistance trial has only recently been harvested and although a final assessment will only be made later some of the results are of interest. At the time of cutting N:Co.339 showed an 84% infection, compared with this were Co.K.32 (89%), N:Co.376 (63%), R.397 (18%) and N:Co.310 (16%). Of the seedlings seven showed no infection while one showed 100% infection.

Table I

Incidence of Mosaic in N.55 Series Resistance Trial

(Commercial and exotic varieties only)

Variety	*% Mosaic in Plant Cane*	*% Mosaic in Ratoon*
Co.360	9.1	13.6
Co.462	—	4.3
Co.617	—	4.2
M.165/38	—	9.1
M.423/41	52.6	94.7
C.B.36/14	—	—
C.B.38/22	—	9.1
C.B.45/27	29.2	12.5
C.B.38/39	—	4.3
Q.50	27.3	77.3
N:Co.292	8.3	—
N:Co.310	4.2	—
N:Co.334	12.5	25.0
N:Co.339	69.6	82.6
N:Co.376	25.0	25.0
N:Co.382	—	—

RATOON STUNTING DISEASE.

1. Investigation into Growth Variation in a Field of N : Co. 334.

The experimental work on this problem was started in 1953 and the fourth and final crop from the field experiment has now been harvested.

The problem originated with a field of N:Co.334 at the Chaka's Kraal Experimental Farm in which according to symptoms observed ratoon stunting disease had caused a pronounced unevenness in growth. In the absence of any symptoms of the disease the better-grown stools were assumed to be free of the disease. The stunted cane exhibited very good symptoms and was taken to be diseased. The treatments for the experiment were as follows :—

H. NIL — assumed healthy cane planted without treatment.

H. HW. — assumed healthy cane treated with hot water (50°C for 2 hours)

D. NIL — assumed diseased cane planted without treatment.

D. HW. — assumed diseased cane treated with hot water (50°C for 2 hours).

As can be seen in Table II there was a very large response to heat treatment in both the assumed healthy and assumed disease cane in the plant cane and first ratoon crops. In the second ratoon crop however definite anomalies were evident possibly due to the fact that the cane was harvested at eleven months.

In the fourth and last crop (3rd ratoon) there was once again a very marked response to heat treatment. Furthermore there was no significant difference between yields from H. NIL and D. NIL on the one hand and between H. HW. and D. HW. on the other suggesting that the assumed healthy cane was in fact infected with the disease. As this was also indicated in previous crops it is obvious that the large stools in the original problem field were infected but showed no obvious symptoms.

Table II

Ratoon Stunting Disease in N:Co.334.

Tons Cane per acre

Treatment	Plant Cane (21 months)	First Ratoon (25 months)	Second Ratoon (11 months)	Third Ratoon (20 months)
H. Nil	55.18	64.72	39.89	34.61
H. HW.	84.92	92.07	33.51	64.75
D. Nil	48.25	61.93	45.25	34.61
D. HW.	79.05	88.22	43.71	64.39

2. Variety Trial (Experiment Station) — Planted 1953.

The third ratoon crop of this experiment was harvested during the year at the age of 20 months. The results show large differences in yield (tons cane per acre) between healthy and diseased cane. These differences are now highly significant in N:Co.291, N:Co.292, N:Co.334 and N:Co.376 and significant in N:Co.310 and N:Co.339 when comparing the HW and NIL INOC. treatments. In a comparison between the HW and HW INOC. all varieties except Co.301 show a decrease in the diseased treatment although only in N:Co.334 and N:Co.339 is this significant (see Table III). The histogram in Fig. 2 shows the yields from the HW. and NIL INOC. treatments for 6 varieties in the 4 crops harvested to date. Taking the mean of 4 crops the yield in diseased N:Co.376 is only 69% that of healthy cane while the corresponding figure for N:Co.292 is 73%.

A comparison of yields from the second and third ratoons suggests that most of the losses due to ratoon stunting disease occur in the second year of the crop. This is most noticeable in N:Co.376.

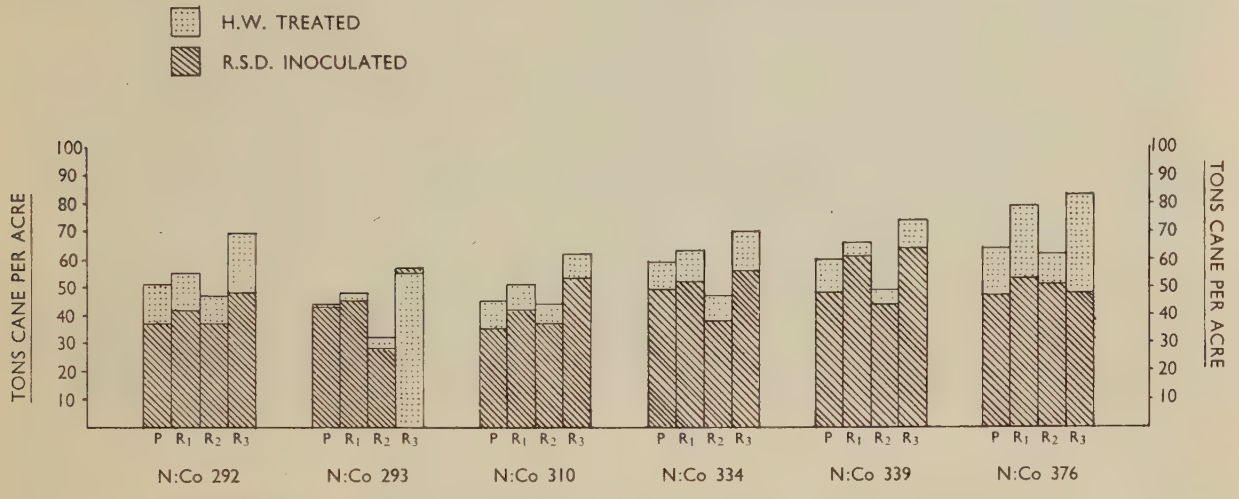


FIGURE II. COMPARATIVE YIELDS OF HOT WATER-TREATED AND R.S.D.-INOCULATED CANE OF SIX VARIETIES

Table III

Ratoon Stunting Disease in Ten Varieties.

Table of Significance

	H.W. — NIL INOC				*H. W. — H.W. INOC*			
	P.	*R1*	*R2*	*R3*	*P.*	*R1*	*R2*	*R3*
Co.281	—	—	—	—	—	—	—	—
Co.301	+	+	—	—	—	+*	+	+
Co.331	+	—	+	—	—	—**	—	—
N:Co.291	+	—*	—**	—**	—	—*	—**	—
N:Co.292	—**	—**	—**	—**	—*	—**	—**	—
N:Co.293	—	—	—	+	—	—	—	—
N:Co.310	—*	—**	—*	—*	—	—	—	—
N:Co.334	—*	—**	—*	—**	—**	—**	—**	—*
N:Co.339	—**	—	—	—*	—*	—**	—	—*
N:Co.376	—**	—**	—**	—**	—	—**	—	—

\+ Increase in disease treatment compared with healthy
* significant difference
— Decrease in disease treatment compared with healthy
** highly significant difference.

3. Ratoon Stunting Disease Trial on Alluvial Soil.

The final crop (3rd ratoon) has now been harvested from this trial and the results of the four crops are shown in Table IV.

This trial has shown a good deal of inconsistency in the results up to now but in the final crop there are significant differences in yield between healthy and diseased cane in all four varieties. In the varieties N:Co.334 and N:Co.376 these differences are highly significant.

Table IV

	Co.331			
Treatment	*P*	*R1*	*R2*	*R3*
Healthy	75.94	68.10	81.10	94.83
Diseased	68.58	59.51	75.41	82.61

	N:Co.334			
Treatment	*P*	*R1*	*R2*	*R3*
Healthy	73.11	63.49	79.09	97.50
Diseased	69.72	70.47	68.97	77.06

L.S.D. (treatments within a variety)
Plant cane : 4.02 @ 5%
Plant cane : 5.61 @ 1%

L.S.D. (treatments within a variety)
2nd Ratoon : 7.12 @ 5%
2nd Ratoon : 9.98 @ 1%

	N:Co.310			
Treatment	*P*	*R1*	*R2*	*R3*
Healthy	63.88	70.11	64.53	86.34
Diseased	63.25	60.73	65.21	76.99

	N:Co.376			
Treatment	*P*	*R1*	*R2*	*R3*
Healthy	78.94	71.36	89.80	111.81
Diseased	78.51	88.87	86.69	89.01

L.S.D. (treatments within a variety)
1st Ratoon : 12.94 @ 5%
1st Ratoon : 18.14 @ 1%

L.S.D. (treatments within a variety)
3rd Ratoon : 9.24 @ 5%
3rd Ratoon : 12.96 @ 1%

4. Residual Effect of Hot Water Treatment.

Past observation in hot water treatment experiments have suggested that some time/temperature combinations have an adverse and lasting effect on the vigour of cane. In order to determine the extent of any such effect an experiment was planted for which seed cane was derived from an earlier H.W.T./germination trial. The cane received no further treatment and the control plots were planted with cane which had never undergone hot water treatment. The two varieties in the experiment were Co.281 and N:Co.310 and the treatments used in the original germination trial were 49°C/3 hours, 49°C/4 hours, 50°C/2 hours, 50°C/3hours, 51°C/2 hours, 51°C/3 hours, 52°C/2 hours, 52°C/3 hours, 53°C/½ hour, and 53°C/1 hour.

There were no significant differences in yield between plots planted with seedcane derived from the original germination trial. However the yields from the untreated controls were significantly lower than those from the remainder of the treatments with the exception of 53°C/½ hour. (see Table V).

Observations made at the time of harvest showed these marked differences between the untreated and previously treated cane and in some cases also between the certain pre-treatments (see Plates 1 and 2). The fact that the latter were not in fact significant is possibly due in part to the design of the experiment.

RED ROT DISEASE.

1. N.53 Series Resistance Trial.

This experiment planted in November 1958 is now in its first ratoon. Very little red rot has been found in the test varieties. However the control Co.290 has also escaped infection to a large degree and what little infection has taken place has been preceded by mechanical damage. Varieties thus damaged and subsequently infected were Co.527, Co.622, M.241/40 and N:Co.339.

2. N.54 and N.56 Series Resistance Trial.

No cases of red rot have so far been found in this experiment even in the control Co.290 although the stalks in the latter have cracked badly and subsequent observations may reveal more red rot infection.

Table V

Residual Effect of Hot Water Treatment

Tons Cane per Acre (Plant Cane)

Treatment in original Germination Trial	*Co.281*	*N:Co.310*
49°C/3 hours	53.45	64.76
49°C/4 hours	57.58	63.73
50°C/2 hours	53.06	69.19
50°C/3 hours	50.14	66.65
51°C/2 hours	53.41	63.77
51°C/3 hours	53.71	63.90
52°C/2 hours	55.09	63.13
52°C/3 hours	58.01	70.99
53°C/½ hour	51.17	57.02
53°C/1 hour	57.71	68.67
Control 1	40.42	49.96
Control 2	34.92	51.82

Note : Control 1. ex untreated control in germination trial (ex commercial field).
Control 2. ex ratoon stunting disease propagation plots.

PLATE I.

Both plots were planted with cane derived from pots for which the seed cane was originally treated in hot water at 49° C. for 5 hours (left) and 50° C. for 3 hours (right) respectively.

PLATE II.

The cane in the left-hand plot (Control 3) has never received heat treatment whereas the plot on the right was planted from a plot for which the seed cane was originally treated in hot water at 51° C. for 3 hours.

GUMMING DISEASE.

1. N.53 Series Resistance Trial.

The varieties in this experiment were assessed for their reactions to gumming disease after 12 months growth as plant cane. The results of this assessment provided the following provisional ratings :—

Resistant —
N.53/87, 53/216
Co's 395, 396, 462, 513, 527, 622, 644
C.P. 31/294, 44/155, 48/103
R.366
28 N.G.253
M.241/40
B.45151
C.B.38/22

Slightly susceptible —
N.53/82
C.P. 38/34, 44/101, 44/154, 51/27

Susceptible —
N:Co.310 (control)
Co.602 (excellent symptoms)
R.397

2. N.54 and N.56 Resistance Trial.

Periodic observations on this experiment planted in October 1960 have shown a satisfactory degree of infection in the control variety N:Co.310. Amongst the test varieties N.56/581, N.56/1086, N.56/1164 and Co.K.32 showed the highest degree of susceptibility with the latter showing symptoms even more severe than N:Co.310.

DISEASE SURVEYS.

Apart from routine inspection work in seedlings and variety trials the industry was extensively surveyed during the year more particularly with regard to mosaic in N:Co.339 and N:Co.376 (see Table VI). Taking as a guide the number of fields found infected and expressing this as a percentage of the total number of fields inspected of each variety it is seen that N:Co.339 is still by far the variety most susceptible to mosaic. The next most susceptible varieties proved to be N:Co.334, N:Co.376 and Co.331. Very pronounced mosaic symptoms and apparent intolerance were exhibited by N:Co.376, N:Co.292, N:Co.293, N:Co.310, N:Co.382 and Salvo.

Most of the mosaic was recorded on the South Coast (Umzinto-Dumisa area) and North Coast (mainly Upper Tongaat), while very little was found in Zululand or in Pongola. In N:Co.339 the mean intensity of infection per field was 64% on the South Coast and only 4% in the Mtunzini-Gingindhlovu area of Zululand. For N:Co.376 the mean was less than 2% although in this variety a large number of individual fields was found infected.

The susceptibility of N:Co.310 to gumming disease, particularly at higher altitudes was still apparent from this survey. Other varieties found with gumming, though to a lesser extent, were N:Co.293, N:Co.334, N:Co.339 and N:Co.376.

Smut disease is still more prevalent on the North Coast and in southern Zululand. Very few fields of Co.301 were inspected but all showed a high percentage infection. Two varieties which should be closely watched because of their apparent susceptibility to smut are N:Co.293 and N:Co.310. Smut disease could prove serious in Pongola particularly in the latter varieties. Fields of N:Co.293 were found in this area with up to 5% infection.

Chlorotic streak was found only in N:Co.310 in the alluvial areas of Umfolozi and the percentage infection in all cases was low.

Table VI

Number of Fields Infected (expressed as % of fields inspected)

	Co. 331	*N:Co. 292*	*N:Co. 293*	*N:Co. 310*	*N:Co. 334*	*N:Co. 339*	*N:Co. 376*	*N:Co. 382*	*Salvo*
Mosaic	23	10	11	5	26	63	24	9	5
Smut	9	—	23	11	—	8	2	—	—
Gumming	—	—	8	24	1	1	2	—	—
Chlorotic Streak	—	—	—	4	—	—	—	—	—

The pre-release varieties Saccharine, Salute, Saraband and Sabre were inspected frequently during the year.

Saccharine shows a susceptibility to rust disease which could prove serious particularly at the higher altitudes. At some sites the rust appears worse than any seen on Co.301 of known high susceptibility. In addition to rust single stools of smut and mosaic were recorded for this variety.

From the disease reaction point of view Salute appears to be the better variety of the first pair. It is not susceptible to rust to the same degree as Saccharine. One stool of Salute was found with chlorotic streak.

Saraband and Sabre are still too young to give more than indications of disease reaction. Both appear to be slightly susceptible to mosaic and susceptible to rust at high altitudes.

QUARANTINE GREENHOUSE.

During the year under review the remaining 35 varieties being held in quarantine in Stellenbosch were transferred to Durban. In addition to the varieties mentioned above a further 33 were imported from Cuba.

Cane Pests

Entomologist : J. DICK.

INVESTIGATION of the problem of eelworms and their effect on sugarcane has continued to be the main project of the entomological section. Although some injury may be caused by free-living nematodes, this investigation has concentrated on internal parasites of the roots, since there are indications that these are more likely to be troublesome in sandy soils. Where counts of worms are quoted, these represent mainly *Meloidogyne javanica* and *M. incognita var. acrita*, although other plant parasites, which occur in smaller numbers, are grouped with them.

Eelworm population studies.

During the 1959-60 season, an extensive survey was carried out, particularly on sandy fields in the North Coast area, to study the distribution and importance of parasitic eelworms as a pest of sugarcane. The degree of infestation of fields was estimated on the basis of counts of eggs, larvae and adults found in samples of cane roots. It was suspected, however, that fluctuations in population density might occur, which could lead to errors in determining the infestation rating of individual fields. Particularly noticeable were a number of instances in which cane showed apparent symptoms of attack but in which microscopic examination revealed the presence of only a small number of worms. It was therefore decided to investigate the magnitude of population fluctuations by regularly repeated sampling of cane roots from a single field.

In September 1960, six small plots were planted with cane of the variety N:Co.382 in a field on Bellamont Estate, Natal Estates Ltd., in which previous sampling had revealed a high population of eelworms. By treating three of the plots with EDB before planting, it was also possible to study the rate of regeneration of populations after fumigation. These plots have been sampled at monthly intervals and the results are given in Table I, in which the figures represent mean numbers of eggs and larvae per subsample examined. Since adults of *Meloidogyne* are not readily extracted by the method used, figures for these are not quoted.

In untreated plots, numbers increased for five months, reaching a peak at the end of February. They then decreased to a minimum in winter and commenced to increase again after the first early spring rain in September. This investigation thus demonstrates that considerable variations in population density occur and indicates that the main trend is seasonal.

Table I

Mean Counts at Monthly Intervals

		Untreated		*EDB*	
		Eggs	*Larvae*	*Eggs*	*Larvae*
Oct.	1960	7.8	9.7	0.2	2.2
Nov.	,,	20.4	29.1	0.7	1.9
Dec.	,,	20.8	25.4	0.5	3.3
Jan.	1961	32.2	49.9	0.8	4.3
Feb.	,,	50.5	62.2	3.2	10.7
March	,,	16.7	44.4	7.0	25.5
April	,,	22.2	44.2	12.6	20.5
May	,,	9.0	33.2	4.0	19.1
June	,,	4.8	20.2	3.6	10.7
July	,,	5.0	19.8	1.2	5.7
Aug.	,,	3.9	14.5	2.9	12.6
Sept.	,,	8.3	29.0	9.8	27.1

In fumigated plots, numbers were at first very small. After about five months, they increased fairly rapidly to a peak in March. At this stage the numbers found in treated plots were somewhat less than half as great as those in untreated plots. After decreasing to a minimum in winter, numbers increased again in early spring. At this stage there was no significant difference between fumigated and untreated plots.

Evidence from other trials, however, indicates that the rate of regeneration after fumigation may vary in different fields and even in different parts of the same field. In another trial planted on Bellamont Estate, differences persisted until the cane was harvested, in September 1961, as a twelve month plant cane crop. This is demonstrated by the figures in Table II, which represent the means of four subsamples for each of three replications.

Table II

Mean Counts, twelve months after planting

	No EDB		*EDB*	
	Eggs	*Larvae*	*Eggs*	*Larvae*
Compost	17.8	27.0	4.8	6.2
Molasses	19.0	17.8	7.1	6.0
Coal Dust	21.7	26.8	4.8	7.7
Control	19.4	20.9	11.7	15.9
Mean	19.5	23.1	7.1	9.0

Similarly, in a variety trial at Mposa, incorporating fumigated and untreated plots of eight varieties of cane, differences were still apparent after 18 months.

Eelworms and Sugarcane Varieties.

In a number of other crops, varietal differences in susceptibility to eelworm attack are known to occur, so that some control can be achieved by cultivation of resistant or tolerant varieties. In order to study possible differences in susceptibility between sugarcane varieties, a trial was laid down in an infested field of red sandy soil at Mposa. Eight varieties were planted in replicated plots, half of which had been fumigated with EDB.

It was considered that differences in susceptibility should be indicated by the degree of response to soil fumigation. A resistant or tolerant variety, being less affected by the presence of eelworms, should show less response than a susceptible variety.

This trial was harvested as an eighteen month plant cane crop in May 1961. The resuls are summarised in Table III.

Table III

	TONS CANE PER ACRE				*TONS SUCROSE PER ACRE*			
			Variety	*EDB*			*Variety*	*EDB*
Variety	*EDB*	*Control*	*Mean*	*Control*	*EDB*	*Control*	*Mean*	*Control*
N:Co.293	54.36	38.71	46.54	1.40	8.51	6.27	7.39	1.36
N:Co.376	56.85	32.23	44.54	1.76	8.86	5.04	6.95	1.76
N:Co.382	60.29	41.57	50.93	1.45	8.22	5.55	6.88	1.48
N:Co.339	56.42	32.66	44.54	1.73	8.18	5.32	6.75	1.54
N:Co.292	51.68	30.50	41.09	1.69	7.24	4.45	5.84	1.63
N:Co.334	50.92	24.37	37.64	2.09	7.60	3.77	5.68	2.02
Salvo	56.63	32.33	44.48	1.75	6.61	4.55	5.58	1.45
Co.331	40.88	25.01	32.95	1.63	5.16	3.34	4.25	1.54

All varieties responded significantly to soil fumigation, the average increase being 21.33 tons cane or 2.77 tons sucrose per acre. Although differences in response between varieties did not pass statistical tests of significance, the fact that the ratio treated:untreated varied from 2.09 for N:Co.334 to 1.40 for N:Co.293 suggested that further investigation might be justified. Other trials of this type, which will include pre-release varieties, are therefore being planted.

Other Field Trials.

In preliminary investigations on control of eelworms in cane fields, separate trials had involved the use of the fumigants D-D, EDB and Nemagon. In an attempt at discovering possible differences in effectiveness between these materials a trial was planted, in May 1959, on an infested field of red sandy soil at Mtunzini. In addition to the fumigants mentioned, a polysulphide preparation, which had shown promise in pot tests, was included. When this trial was harvested as a two year plant cane crop in 1961, the results were as summarised in Table IV. The variety was N:Co.382.

Table IV

	Tons cane per acre	*Tons Sucrose per acre*
Control	60.95	7.77
Polysulphide	65.67	7.76
EDB	69.26	7.94
Nemagon	60.05	7.37
D-D	67.42	7.48

Although, during the early growth, differences between treated and untreated plots had been noticed, there was no significant difference at the time of harvest.

During the period under review, an additional four field trials were planted. Treatments included combinations of fertilizers and soil ameliorants with soil fumigation.

Glasshouse Tests.

A considerable number of pot tests on possible control measures has been carried out. In these, tomatoes were used as test plants and the criterion for comparison was the number of nodules which

developed on the roots. Since conditions in pots are different from those in the field, the results of these tests cannot be applied directly to practical control but are of value, for example, in preliminary screening of chemicals before they are tried in the field.

During winter, pot tests using soil collected in the field have given inconclusive results since the numbers of eelworms and nodules found in untreated pots have been small. This is associated with the seasonal fluctuation in eelworm populations which has already been mentioned. It has now been decided to resort to artificial infestation of soil for such tests.

Since yellow oxide of mercury has elsewhere been found to give some control of nematodes, this material was investigated in tests in which the corresponding, much less costly, oxide of lead was also included. Results appeared to indicate that the oxide of lead might be as effective as that of mercury and this chemical has now been included in a field trial. Examination of sugarcane roots from this trial, five months after planting, yielded the figures shown in Table VI.

Table VI

Mean Counts five months after planting.

	Eggs	*Larvae*
EDB	2.0	19.8
Lead oxide	2.8	23.8
Control	14.0	42.8

Although sampling must be repeated before conclusions can be drawn, these figures appear to indicate a response to lead.

Another series of tests from which interesting results are being obtained, involves the use of liberal applications of ammonium hydroxide. In a preliminary trial, this material was applied, in the most concentrated solution available, at rates equivalent to 100, 200 and 400 pounds of nitrogen per acre. Counts of nodules on tomato roots, six weeks after planting, gave the figures shown in Table VII.

Table VII

Ammonium hydroxide to give :	*Mean nodules per 4 plants.*
400 lb. N per acre	17.0
200 lb. N per acre	68.2
100 lb. N per acre	127.2
Control	257.2

In a second experiment, ammonium hydroxide or urea were applied, at rates equivalent to 400 or 200 pounds nitrogen per acre, to soils collected in two separate fields. Since germination in the pots receiving the higher dose of urea was poor, tomato seeds were replanted in small patches of heat-sterilized soil inserted into the pots. Counts of nodules on the tomato roots, six weeks after planting, gave the figures in Table VIII.

Table VIII

Treatment *Ammonium Hydroxide*	*Mean nodules per 4 tomato plants*	
	Lagoon Field	Twalange Field
400 lb. N per acre	3.0	1.0
200 lb. N per acre	17.5	15.9
Nil	38.5	159.1
Urea		
400 lb. N per acre	18.5	12.5
200 lb. N per acre	45.2	89.0
Nil	46.4	163.8

Since differences in growth were apparent, the tomato plants were weighed six weeks after planting. The weights, which are demonstrated in Table IX, indicated a marked response to nitrogen, either as ammonium hydroxide or as urea, at the 200 pound level. The decrease in response beyond this level was mainly due to root injury by the high concentration of nitrogenous material in the soil.

Table IX

Treatment *Ammonium hydroxide*	*Mean Weight for 4 tomato plants*	
	Lagoon Field	Twalange Field
400 lb. N per acre	11.78	2.05
200 lb. N per acre	18.96	6.25
Nil	3.36	1.48
Urea		
400 lb. N per acre	24.89	5.21
200 lb. N per acre	25.45	6.30
Nil	3.10	1.22

The results of these tests are sufficiently promising to justify further investigation on a field scale.

Other aspects of chemical control which are being investigated include the effects on soil and nematode populations of large applications of sugar or molasses, the comparative effectiveness of a number of different soil fumigants, and the effect on nematode mortality of distance from the point of application of these substances.

Fertilizers

Advisory Chemist : T. A. F. SEXTON

The decline in the number of samples of both soils and leaves submitted for analysis has continued during the year under review, and, in view of the present restrictions seems destined to do so until such time as the production position improves.

The Table I below shows the record of all samples received since the service was inaugurated.

Table I

Advisory Samples	1955-56	1956-57	1957-58	1958-59	1959-60	1960-61	Grand Total
Soils	5,563	5,138	3,843	8,365	6,763	5,786	35,458
Leaves	2,420	3,133	1,241	1,555	1,719	1,153	11,221
Fertilizers and Miscellaneous	121	336	517	259	335	260	1,828
Total :	8,104	8,607	5,601	10,179	8,817	7,199	48,507
Experimental Samples							
Soils from Regional Fertilizer Trials	0	895	1,020	810	565	643	3,933
Leaves from Regional Fertilizer Trials	0	1,767	5,246	4,343	5,547	675	17,578
General Experimental Soils	89	630	1,218	1,574	1,462	2,222	7,195
General Experimental Leaves	178	2,194	2,402	676	1,227	447	7,124
Total :	267	5,486	9,886	7,403	8,801	3,987	35,830
Yearly Totals :	8,371	14,093	15,487	17,582	17,618	11,186	84,337

Review of Weather Conditions

RAINFALL.

The average rainfall for 54 recording stations scattered throughout the sugar belt was 46.43 inches for the year ending 31st May, 1961, which was well above our 37 years' mean of 38.49 inches.

As is usual with us the winter of 1960 was dry and sufficient rain did not fall until rather late in September. Good rains fell and excellent growing conditions prevailed from October 1960 up to April 1961 and although May was dry the crop prospects at the end of this month were most promising.

The average monthly rainfall from the 54 recording stations and the monthly evaporation from an open water surface at the Experiment Station were as follows :—

	Mean rainfall in inches 1924-1960	Actual rainfall in inches June 1960-May 1961	Mean evaporation in inches 1936-1960	Actual evaporation in inches June 1960-May 1961
June	1.42	0.43	2.35	2.38
July	1.06	0.63	2.53	2.65
August	1.39	1.06	2.90	2.27
September	2.08	2.30	3.60	3.51
October	3.52	3.14	4.15	4.07
November	4.31	7.24	4.74	5.08
December	4.83	9.59	5.30	4 .85
January	4.31	4.76	5.62	5.68
February	4.81	3.70	4.73	5.48
March	5.25	4.36	4.46	4.88
April	2.94	8.24	3.35	3.70
May	2.07	0.98	2.79	2.94
Annual	38.49	46.43	46.52	47.49

Although the rainfall for the year was well above normal, irrigation would still have benefited the crop during most months of the year.

TEMPERATURES AND SUNSHINE.

The mean screen temperature at the Experiment Station was 69.6°F or 0.9° above the 33 years' mean. The only months with a mean temperature below average were June, July and September 1960 and May 1961, while August, January and March had mean temperatures in excess of 2°F above their respective averages.

The hours of sunshine for the year under review were 101.3 per cent of the 33 years' mean but the hours of sunshine from March to June 1961 were only 91.9 per cent of the mean and a low sucrose per cent cane for the year seems indicated.

SUMMARY AND CONCLUSIONS.

With an excellent total rainfall which was fairly well distributed and a relatively high temperature for the year, the crop had most favourable weather conditions and an excellent yield can be expected. It is however possible that the sucrose per cent cane may be somewhat low.

Appendix 1

Exchange of Varieties and the Early Stages of Seedling Raising and Selection.

VARIETIES INTRODUCED.

During the 1960-61 year, the following varieties were introduced into Natal from other countries :

Australia — Cadmus, E.P.C.39/375, E.P.C.39/393, H.32/6774, H.35/198, H.39/5803, I.216, Luna, 30 M.Q.2313, 33 M.Q.371, 33 M.Q.537, 36 M.Q.2717, 54N.6441, 54N.7103, 51N.G.140, 57N.G.155, 57N.G.191, 57N.G.208, P.B.52/1/1, P.B.52/1/7, P.O.J. 3046, P.O.J.3100, Q.66, Q.69, Q.72, Q.73, 47R.2777, Triton, Vidar.

Brazil — C.B.45/3, C.B.47/15, C.B.48/90, C.B.55/72, C.B.55/96, C.B.56/86, C.B.56/171.

Cuba — J.52/16, J.56/43/21/5, J.56/43/24/1, J.59/3/81/14, J.59/4/62/19, J.59/4/77/12, J.59/4/78/3, J.59/4/86/3, J.59/4/87/4, J.59/5/15/4, J.59/5/19/13, J./59/7/34/14, J.59/7/37/6, J.59/7/37/12, J.59/7/51/9, P.B.51/1/4.

Mauritius — Ebéne 50/47, M.253/48.

Mexico — Mex.52-17, Mex.52-29, Mex.52-56, Mex.53-142, Mex.54-81, J.Mex.55-1601.

Appendix I

VARIETIES EXPORTED.

The following varieties were sent in exchange to other countries :

Mauritius	—	B.45151, C.B.41/35, C.B.45/6, Co.331, H.39-7028, N.10, N.50/211, N.52/219, N.55/176, N:Co.382.
Mexico	—	N.50/211, N:Co.376, N:Co.382.
Pakistan	—	Co.686, Co.779, Co.S.109, 6.E, E.16, H.M.619, M.241/40, N.50/211, P.R.905, P.T.51/341, Q.63.
Paramaribo	—	N.50/211.
N. Rhodesia	—	B.41/227, C.B.36/14, C.P.29/116, Ebéne 1/37, N:Co.310, N:Co.334, N:Co.376, Pindar, P.O.J.2878, Q.50.
Taiwan	—	N.51/168, N.52/340.
U.S.A.	—	N.50/211.

SEEDLINGS RAISED IN 1960 FROM SEED PRODUCED IN 1959.

Parentage	No. of female tassels	No. of Seedlings Germinated (Estimated)	No. of Seedlings Planted in field
Co.205 x N:Co.293	2	1,950	1,819
Co.301 x Co.285	2	0	0
Co.301 x Co.331	2	2,500	2,196*
Co.301 x Co.421	2	42	39
Co.301 x N:Co.292	4	0	0
Co.301 x N:Co.293	1	8	7
Co.301 x N:Co.376	2	0	0
Co.301 x N:Co.390	2	8	5
Co.312 x Co.301	1	1,200	546*
Co.312 x Co.421	5	220	216
Co.331 x Co.205	2	410	391
Co.331 x Co.285	2	450	432
Co.331 x Co.301	2	220	205
Co.331 x Co.421	8	530	508
Co.331 x 5E	2	3	3
Co.331 x N:Co.292	6	4	4
Co.331 x N:Co.293	13	300	289
Co.331 x N:Co.376	4	130	126
Co.331 x N:Co.382	2	0	0
Co.331 x N:Co.390	2	9	9
Co.421 x Co.312	3	1,440	1,368
Co.421 x Co.331	6	4,000	3,559
C.P.44/155 x Co.312	1	750	446*
H.M.619 x Co.285	1	4	4
H.M.619 x Co.301	1	13	13
N.51/101 x Co.301	1	1	1
N.52/445 open cross	1	25	25
N.53/181 x N:Co.293	1	8	7
N.55/176 open cross	1	188	181
N.56/1341 x Co.285	1	235	233
N.56/1341 x N:Co.293	1	275	270
N.56/1341 x N:Co.376	1	11	10
N.56/1353 x N:Co.293	1	4	4
N.56/1358 x N:Co.293	1	94	91
N.56/1379 x Co.331	2	800	393*
N.56/1383 x N:Co.293	1	440	425
N.56/1391 x Co.331	2	16	16
N.56/1392 x N:Co.376	1	9	8
N.561395 x Co.331	1	504	492
N.56/1396 x Co.331	1	7	7
N.56/1410 x Co.301	1	20	20
N.56/1410 x Co.331	1	14	14
N.56/1410 x N:Co.293	1	9	7
N.56/1414 x Co.331	1	215	209
N.56/1415 x Co.301	1	200	192
N.56/1415 x Co.331	1	118	116
N.56/1415 x N:Co.376	1	61	60
N.56/1419 x Co.331	1	498	495
N.56/1424 x Co.285	1	109	109
N.56/1424 x N:Co.293	1	35	35
N.56/1426 x N:Co.293	1	17	16
N.56/1431 x N:Co.376	1	140	140
N.56/1439 x N:Co.293	1	2	1
N.56/1448 x N:Co.293	1	170	169
N.56/1454 x N:Co.293	1	1	1
N.56/1459 x N:Co.293	1	9	9
N.56/1459 x N:Co.376	1	14	14
N.56/1460 x N:Co.293	1	28	27
N.56/1473 x N:Co.376	1	4	3
N.56/1475 x N:Co.376	1	5	5
N.56/1483 x Co.331	1	12	12
N.56/1490 x Co.331	1	86	85

Parentage	No. of female tassels	No. of Seedlings Germinated (Estimated)	No. of Seedlings Planted in field
N.56/1492 x Co.331	1	65	65
N.56/1500 x Co.331	1	4	3
N.56/1510 x Co.331	1	5	5
N.56/1511 x Co.331	1	190	180
N:Co.292 x Co.301	2	1,650	1,538
N:Co.292 x Co.331	9	2,350	2,200*
N:Co.292 x N:Co.382	2	3,200	543*
N:Co.293 x Co.205	4	1,450	1,370
N:Co.293 x Co.285	2	1,050	551*
N:Co.293 x Co.301	2	600	549
N:Co.293 x Co.331	13	6,100	5,815*
N:Co.293 x N:Co.382	2	680	670
N:Co.310 x Co.285	10	850	735
N:Co.310 x Co.301	9	600	582
N:Co.310 x Co.331	14	3,000	2,911
N:Co.334 open cross	1	14	14
N:Co.339 x Co.301	2	1,700	1,613
N:Co.339 x Co.331	7	2,350	2,245
N:Co.376 x Co.205	2	1,600	548*
N:Co.376 x Co.285	2	350	323
N:Co.376 x Co.301	3	1,850	1,786
N:Co.376 x Co.331	10	5,600	5,308
N:Co.376 x N:Co.293	1	300	279
N:Co.382 x Co.331	2	260	254
P.O.J.2803 x Co.331	1	340	325
87 Crosses	221	54,733	46,499

* Some seedlings were also planted in bunches. Altogether about 7,000 seedlings were planted in 602 bunches.

SEEDLINGS PLANTED AS MICRO-LINES (on environment stations) IN 1960.

Parentage	No. Planted
Co.205 x N:Co.293	41
Co.421 x Co.301	128
Co.421 x Co.312	882
Co.421 x Co.331	113
Co.421 x G.255	80
Co.421 x Hind's Special	76
Co.453 x N:Co.293	52
C.P.27/108 x Co.331	223
C.P.27/108 x N:Co.382	78
C.P.36/85 x N:Co.382	87
N:Co.291 x Co.331	58
N:Co.292 x Co.331	249
N:Co.293 x Co.301	305
N:Co.293 x Co.331	174
N:Co.376 x Co.301	80
N:Co.376 open cross	14
N.M.222 x Co.331	46
N.M.222 x N:Co.293	121
P.O.J.2803 x Co.205	85
Total 19 crosses	2,892

N SERIES SINGLE LINES PLANTED IN MARCH, 1961.

Parentage	No. Planted
Co.205 x Co.331	9
Co.205 x N:Co.293	9
Co.281 Selfed	1
Co.301 x Co.285	9
Co.301 x Co.356	1
Co.301 x G.255	2
Co.301 x N.56/1312	22
Co.301 x N:Co.293	18
Co.301 x 51 N.G. 70	1
Co.331 x Co.285	41
Co.331 open cross	2
Co.331 x U.S. 1694	8
Co.356 x Co.331	15
Co.419 x Co.331	3
Co.421 x Co.312	37
Co.421 x Co.317	1

Parentage	No. Planted
Co.421 x C.P.29/116	2
Co.421 x N:Co.293	15
Co.421 x N:Co.376	5
Co.421 x N.M.37	1
Co.453 x N:Co.293	45
Co.453 x N:Co.382	1
Co.453 x Uba Marot	1
C.P.34/120 x G.255	1
C.P.34/120 open cross	2
C.P.34/139 x Co.285	1
C.P.34/139 x N:Co.382	21
C.P.36/111 open cross	4
C.P.36/191 x Co.331	30
5 E x Co.285	9
G.256 x Co.331	4
H.M.619 x Co.301	1
N.10 x Co.285	23
N.10 x U.S.1694	8
N.50/123 x Co.285	6
N.50/123 x Co.331	2
N.51/783 x Co.331	1
N.52/408 x Co.331	10
N.53/193 x Co.331	8
N.54/551 open cross	1
N:Co.79 x N:Co.382	1
N:Co.291 x Co.285	2
N:Co.291 x Co.527	4
N:Co.291 x N:Co.390	2
N:Co.292 x Co.301	34
N:Co.292 x Co.312	6
N:Co.292 x N:Co.382	25
N:Co.293 x Co.285	4
N:Co.293 x Co.331	14
N:Co.293 x Co.527	11
N:Co.293 x G.256	4
N:Co.293 x N.51/1069	6
N:Co.293 x N.56/1312	14
N:Co.293 x N.56/1322	1
N:Co.293 x 51 N.G. 70	1
N:Co.293 x Uba Marot	4
N:Co.310 x Co.331	50
N:Co.310 x N.M.222	7
N:Co.339 x Co.331	109
N:Co.339 x C.P.36/85	1
N:Co.339 x N:Co.293	28
N:Co.339 x N:Co.382	1
N:Co.339 x N.M.37	4
N:Co.339 x S. rob. sdlg.	4
N:Co.349 x Co.285	4
N:Co.349 x Co.312	5
N:Co.349 x Co.331	4
N:Co.349 x N:Co.376	2
N:Co.376 x Co.205	20
N:Co.376 x Co.331	22
N:Co.376 x Co.527	11
N:Co.376 x G.256	1
N:Co.376 x N.121	2
N:Co.376 x N.51/1069	3
N:Co.376 x N.56/1312	31
N:Co.376 x N.56/1322	3
N:Co.376 open cross	136
N:Co.376 x Uba Marot	103
N:Co.376 x U.S.1694	12
N:Co.382 x Co.331	28
N:Co.382 x U.S.1694	4
N.M.37 x N:Co.382	1
N.M.37 x N:Co.390	3
N.M.222 x Uba Marot	2
P.O.J.2725 x Co.285	2
P.O.J.2725 x Co.331	9
P.O.J.2725 x N:Co.382	5
Uba x Co.331	2
Uba x N:Co.376	2
Uba Marot open cross	14
	1.149

Appendix 2

PUBLICATIONS OF THE EXPERIMENT STATION 1960-61

BULLETINS

No. 12.	Trashing.
No. 13.	A Guide to the use of fertilizers.

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Dick, J.	Eelworms and Sugarcane. Proc. S.A.S.T.A. 1961.
Brassey, T. B.	Present varieties in pre-release trials. Proc. S.A.S.T.A. 1961.
Pearson, C. H. O. et al	Attempts to confirm irrigation control factors based on meteorological data in the cane belt of South Africa. Proc. S.A.S.T.A. 1961.
Pearson, C. H. O.	The examination of the critical period of growth of a sprouting cane sett when weed competition must be eliminated. Proc. S.A.S.T.A. 1961.
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N:Co.310 Too Old at Fourteen	,,	No. 7.
Establishment of seed cane nurseries	,,	,,
Report on a visit to Mauritius	,,	,,
A guide to the use of fertilizers	,,	No. 8.
Experimental results and cutting the cost of cane production under restriction	,,	,,
Effects of frost on sugarcane	,,	No. 9.
Co-ordination of Soil Survey	,,	,,
Weeds — what must we do about them	,,	No. 10.
S.A. Sugarcane varieties to be given names	,,	No. 12.
Urea	Vol. 45	No. 3.
Coffee	,,	No. 6.

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No. 1.	1956.	Gumming disease in Natal.
No. 2.	1957.	Fertilizer responses.
No. 3.	1957.	Comparative yielding ability and disease resistance of South African cane varieties.
No. 4.	1957.	The identification of the more important sugarcane varieties grown in South Africa.
No. 5.	1957.	The growth and development of the sugarcane plant.
No. 6.	1958.	Sucrose formation and concentration in sugarcane.
No. 7.	1958.	The production of new sugarcane varieties for Natal.
No. 8.	1958.	Sugarcane pests in South Africa.
No. 9.	1958.	Diseases of sugarcane in Natal.
No. 10.	1959.	The development of sugarcane breeding in South Africa.
No. 11.	1960.	Liming in the sugar industry.
No. 12.	1960.	Trashing.
No. 13.	1960.	A guide to the use of fertilizers.